農業研究

第十卷　第一期

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新引進稻品種適應性試驗報告（第一報）

林　昌　武

一、緒　　言

本省地處亞熱帶，因得天時地利之便，一年數作並不困難，即使未能設立早熟稻品種改良機構，至少需要及早有一全省性水稻早熟品種區域適應試驗，以期早日育成一、二兩期作通用或二期作專用之早熟稻品種。以目前本省缺少二期作性品種之情形下，如欲育成感光性强之品種，除利用日本稻爲雜交材料之外，以日本晚熟稻之感光性進行馴化、選育早熟、質優、豐產之二期作性水稻亦爲一有效之途徑。據預料將來如能育成產量與中、晚熟稻略同之早熟品種：(一)不但可使農民之勞力調節較前輕鬆，同時有利於裏作或輪作栽培，且不致影響糧食增產之目標。(二)對於抽穗或稔實期間季節風較强之新竹、苗栗方面及易受冷害、雨害之北部可減輕氣象的災害。（據作者(1954)[6]之研究除特殊情形之外，支配北部水稻豐歉之因子爲6月及10月份之雨量，如6月、10月份雨量過多，則該年稻作大體爲歉收，即在6月份適當第一期作水稻抽穗開花之前後；在10月份適當第二期作水稻抽穗開花前後，必須希望天晴）。(三)宜蘭地區二期作栽培在來種之趨勢可逐漸減少（一般蓬萊種成熟時適逢雨季，農民常以可提早收穫之在來種代替之）。

過去早熟稻之所以未能大面積推廣，乃由於早熟與產量之相關密切，即早熟之結果勢必減低產量10～20%，因此除配合裏作、輪作必須種植早熟稻以外，大部份均不願採用早熟稻。雖然過去早熟稻減收爲一無可否認之事實，但育成早熟而豐產之品種仍爲育種人員所尋求目標之一。日本近年來[5]由於推廣早期、早植、早熟品種如藤坂5號、豐年早生等已大爲提高稻米產量而增加農民收益。而在九州鹿兒島設立早期、早熟品種之改良機構，從事稻米增產試驗。

就本省早熟稻育種而言，雖亦已育成接近理想之品種，但在技術上（例如研究早熟之條件、形質）及適應性方面之試驗制度尙未確立，有待進一步檢討。

本試驗進行中，蒙　繆主任進三指導，並承臺中、高雄區農業改良場、臺南區農業改良場嘉義分場鼎力協助，皆不勝感激之至。本文復蒙　繆主任進三校閱，徐所長水泉指示與鼓勵發表，謝順景先生惠予幫助，一併在此謹申謝意。

二、新引進稻之試驗經過

民國44年間糧食局爲改良稻米品質(據報載)曾從日本引進一批稻種，不久相繼由農復會、農試所、臺大分別派員考察日本農業並帶回多數之日本稻品種交由各試驗改良機構進行馴化改良工作，惟日本稻引進本省栽培後，因其對於短日照敏感、分蘖減少、抽穗亦不整齊。除極少數品種勉可利用外，大部份未具經濟價值（例如農林39號產量雖略優，但較臺中65號仍減收 5～10%，農林21號及41號有時產量表現雖佳，惟容易發生不稔粒，產量仍不穩定）。農試所雖限於人力、經費未能就全數引進稻擧行觀察及馴化改良，惟自44年第二期作起曾就引進本省之52個（糧食局送交農試所部份除農林93號之外，其他51個品種均已先由農試所繆主任進三自日本引進。關於特性觀察部份將於另文發表）農林各號稻種進行觀察結果，於45年第二期作（因鑒於日本晚熟稻對於短日照敏感，於第二期作不但抽穗提早，同時由於秋季稔實甚佳，可認爲有利於選拔二期作性早熟稻）經過純系分離，選出農林21號-A等9個品系。其中農林65號-A經過選育比較試驗結果，於第二期作環境下，不但較臺中65號早熟7～9天，且產量亦超過19%。經檢討考慮於48年第二期作開始編列預算分別

在臺北(農試所)、臺中、屏東各改良場進行適應性試驗。經二年來試驗結果獲知農林48號 -A (中熟品種) 及農林65號 -A (二期作性早熟品種) 地方適應性尙佳。其產量在臺北、臺中、嘉義、屏東各地均有良好之表現。

三、試驗材料與方法

(一)試驗地點：臺北(農試所)、臺中、屏東(改良場)。

(二)試驗品種：農林24號、農林55號、農林73號、農林48號 -A、農林65號 -A、臺中65號等6個品種，另外對照品種由各試驗場所選定當地中、早熟品種二品種，共計8個品種。

(三)試驗方法：用逢機區集法設計，重複四次，行長四公尺，5行區，每行植20株，行株距爲25×20 cm，每株5本苗。栽培方法及肥料用量依照當地標準進行。

四、試 驗 結 果

48年第二期作

根據47年第二期作及48年第1期作品種比較試驗結果，農林48號 -A、農林65號 -A產量可較臺中65號增加4％～19.9％。本試驗於48年第2期作起分別在臺北、臺中、屏東三處擧行適應性試驗。試驗結果以農林48號 -A產量較高，比臺中65號三處平均增收13.4％其次爲農林65號 -A較臺中65號平均增收12.9％(早熟7～9天)。48年第2期作各地試驗之綜合結果如下：

試驗地	項目／品種名	生育日數	稈長	每叢穗數	平均產量 公斤/公頃	產量指數			備考
						對CK1	對CK2	對臺中65	
臺北	農林24號	49	83.6	15.0	3,090.0	96.5	99.3	88.1	直立
	農林55號	45	80.6	14.4	3,042.5	95.0	97.8	86.7	〃
	農林73號	47	79.9	15.8	3,155.0	98.5	101.4	90.0	稍倒
	農林48號-A	61	93.5	13.7	3,652.5	114.1	117.4	104.1	直立
	農林65號-A	56	95.1	12.6	4,135.0	129.1	132.9	117.9	〃
	臺中65號	64	89.8	12.9	3,507.5	109.5	112.7	100	〃
	CK1 新竹4號	51	91.9	12.9	3,202.5	100	102.9	91.3	〃
	CK2 農早1號	50	90.1	12.4	3,112.5	97.2	100	88.7	〃
臺中	農林24號	49	99.1	12.5	3,130.0	89.4	83.4	79.9	稍倒
	農林55號	47	87.2	13.1	3,371.0	96.2	89.9	86.0	直立
	農林73號	47	87.8	13.0	3,459.0	98.7	92.2	88.2	〃
	農林48號-A	60	100.8	11.8	3,810.0	108.8	101.6	97.2	〃
	農林65號-A	56	102.8	12.4	4,165.0	118.9	111.0	106.3	〃
	臺中65號	60	98.3	12.9	3,920.0	111.9	104.5	100	〃
	CK1 臺中180號	50	94.5	12.8	3,503.0	100	93.4	89.4	〃
	CK2 臺中150號	57	103.4	12.6	3,751.0	107.1	100	95.7	〃
屏	農林24號	56	85.3	12.4	2,448.5	77.3	89.5	96.9	〃
	農林55號	50	82.4	14.1	2,363.0	74.6	86.4	93.5	〃
	農林73號	50	78.4	14.8	2,128.5	67.2	77.8	84.2	〃
	農林48號-A	64	101.0	9.9	3,513.0	110.9	128.5	139.0	〃
	農林65號-A	60	93.9	8.8	2,895.0	91.4	105.9	114.5	〃

	臺 中 65 號	69	98.6	7.4	2,528.0	79.8	92.4	100	〃
東	CK1 農林 41 號	57	83.4	17.0	3,168.0	100	115.8	125.3	〃
	CK2 高雄 25 號	64	97.8	8.2	2,735.0	88.2	100	108.2	〃

插秧期：臺北 8 月 3 日，臺中 7 月27日，屏東 7 月18日。

49年第 1 期作

本期作係繼續上年第 2 期作仍在臺北、臺中、屏東三處舉行。供試品種試驗方法與上年同。試驗結果以農林48號-A產量較高，比臺中65號四處（包括嘉義分場）平均增收 6.2%。生育日數與臺中65號略同。根據其生育日數不能當作早熟稻。惟在各地之產量比較穩定似適應性良好，將來或可參加蓬萊稻區域試驗。至於早熟品種農林73號在臺北、嘉義、屏東亦有良好之表現。其生育日數較臺中65號提早一週，而三處平均產量亦超過臺中65號 1.3%。

本年第 1 期作各地試驗之綜合結果如下：

試驗地	項目 / 品種名	生育日數	稈長	每叢穗數	平均產量 公斤/公頃	產量指數 對 CK1	對 CK2	對臺中65
臺	農 林 24 號	85	95.9	17.4	3,658	65.3	98.5	91.2
	農 林 55 號	80	93.5	17.6	3,316	85.8	89.3	82.7
	農 林 73 號	84	95.1	18.6	3,796	98.2	102.3	94.7
	農 林 48 號-A	95	108.9	17.4	4,066	105.2	109.5	101.4
	農 林 65 號-A	93	107.0	16.4	3,838	99.3	103.4	95.7
	臺 中 65 號	95	107.3	15.5	4,010	103.7	108.0	100.0
北	CK1 新 竹 4 號	91	106.3	17.2	3,866	100.0	104.1	96.4
	CK2 臺中150號	93	104.3	17.2	3,712	96.0	100.0	92.6
臺	農 林 24 號	67	90.0	15.3	3,234	93.1	81.4	84.3
	農 林 55 號	66	88.5	13.7	2,374	68.4	59.8	61.9
	農 林 73 號	72	92.2	14.2	3,104	89.5	78.1	80.8
	農 林 48 號-A	81	103.2	16.5	4,054	116.8	102.1	105.7
	農 林 65 號-A	76	99.4	15.2	3,330	96.0	93.8	86.8
	臺 中 65 號	78	102.6	18.4	3,836	110.5	96.6	100.0
中	CK1 臺中180號	69	88.1	15.6	3,470	100.0	87.3	90.5
	CK2 臺中150號	75	100.4	17.5	3,972	114.5	100.0	103.5
屏	農 林 24 號	72	91.8	14.4	4,102	95.7	89.4	84.6
	農 林 55 號	71	90.5	13.7	4,156	97.0	90.5	85.7
	農 林 73 號	74	93.0	14.3	4,952	118.3	107.9	102.2
	農 林 48 號-A	82	96.7	12.7	5,216	121.7	113.6	107.6
	農 林 65 號-A	76	95.4	13.2	4,286	100.0	93.4	88.4
	臺 中 65 號	81	100.1	13.3	4,848	113.1	105.6	100.0
東	CK1 農林 41 號	74	88.0	15.1	4,286	100.0	93.4	88.4
	CK2 高雄 25 號	76	98.3	12.2	4,590	107.1	100.0	94.7
嘉	農 林 24 號	69	82.8	16.0	3,079	(對臺中180) 107.1		83.2
	農 林 21 號	63	75.1	18.4	2,215	77.1		59.9
	農 林 73 號	71	88.5	17.0	3,959	137.8		107.0

	農林48號-A	78	101.6	12.7	4,067	141.5		109.9	
	農林65號-A	72	94.8	14.5	3,801	132.3		102.7	
	嘉南8號	82	96.1	13.3	4,477	155.8		121.0	
義	臺中65號	78	98.6	11.8	3,700	128.7		100.0	
	臺中180號	70	83.8	12.5	2,874	100.0		77.7	

備註：嘉義部份係摘錄嘉義分場早熟品種比較試驗成績。
插秧期——臺北3月9日，臺中2月23日，屏東1月19日，嘉義2月15日。

49年第2期作

本試驗按照計劃本年爲第2年。試驗地點仍在臺北（本所）、臺中、屏東三處舉行。供試品種試驗方法與上年相同。試驗結果以農林65號－A產量較高，比臺中65號三處（屏東部份水稻生育過差，由嘉義分場摘錄之資料代替）平均增收8.5%。生育日數較臺中65號三處平均提早7天。其次爲農林48號－A較臺中65號三處平均增收3.2%。

本年第2期作各地試驗之綜合結果如下：

試驗地	項目 / 品種名	生育日數	稈長	每叢穗數	平均產量 公斤/公頃	產量指數 對CK1	產量指數 對CK2	產量指數 對臺中65	備考
臺北	農林24號	55	104.9	13.4	2,700	82.7	77.1	82.1	直
	農林55號	51	80.1	10.1	1,923	59.6	54.9	58.4	〃
	農林73號	52	80.5	14.1	3,082	94.4	88.0	93.7	〃
	農林48號-A	67	95.3	11.9	3,166	96.9	90.4	96.2	〃
	農林65號-A	60	94.8	13.5	4,008	122.7	114.4	121.8	〃
	臺中65號	68	93.4	11.2	3,290	100.7	94.0	100.0	〃
	CK1 新竹4號	58	97.3	11.7	3,266	100.0	93.3	99.3	〃
	CK2 臺中150號	63	96.9	12.4	3,502	107.2	100.0	106.4	〃
臺中	農林24號	55	96.1	14.8	3,185	88.0	83.8	72.2	〃
	農林55號	51	86.9	13.4	3,485	96.3	91.7	79.0	〃
	農林73號	53	87.8	15.1	3,282	90.7	86.4	74.4	〃
	農林48號-A	61	102.8	12.2	4,296	118.7	113.1	97.3	〃
	農林65號-A	57	103.6	12.8	4,245	117.3	111.7	96.2	〃
	臺中65號	62	103.6	12.6	4,414	122.0	116.2	100.0	〃
	CK1 臺中180號	54	97.4	13.7	3,619	100.0	95.2	82.0	〃
	CK2 臺中150號	59	104.6	13.7	3,800	105.0	100.0	86.1	〃
嘉義	農林24號	56	103.3	14.5	3,726	(對臺中180) 92.2		82.1	倒菌核病輕
	農林73號	55	95.5	13.7	3,937	97.4		86.8	倒鳥害菌核病輕
	農林48號-A	66	115.4	11.3	5,272	130.4		116.2	直
	農林65號-A	60	112.1	12.3	4,872	120.5		107.4	倒輕菌核病輕
	嘉南8號	70	111.6	11.6	4,130	102.1		91.0	倒菌核病重
	臺中65號	67	115.5	11.7	4,537	112.2		100.0	直
	臺中180號	55	102.3	12.4	4,043	100.0		89.1	〃

備註：1. 嘉義部份係摘錄嘉義分場早熟品種比較試驗成績。
2. 屏東部份水稻生育過差試驗結果無法比較。
插秧期——臺北8月2日，臺中7月27日，嘉義7月20日。

五、討論及摘要

一、根據自47年第二期作起迄49年第二期作之試驗結果，第一期作以農林48號 -A作為一般中熟稻較有希望，據試驗結果49年第一期作在臺北、臺中、嘉義、屏東各地均有良好之表現，其產量較臺中 65 號四處平均增加 6.2%，生育日數與臺中65號略同（但以目前鑒於第一期作優良品種已甚多，有待進一步參加蓬萊稻區域適應試驗）。至於抗病性方面尚須檢定。早熟稻農林73號於第一期作在臺北、嘉義、屏東各地亦有良好之表現。其生育日數不但較臺中65號提早一週而產量亦超過臺中65號 1.3 %。較其他當地早熟稻（CK 1. CK 2）其生育日數雖略同，但在臺北、嘉義、屏東三處之平均產量可超過當地早熟稻 12.9%。

二、第二期作以農林65號 -A產量較高，不但較臺中65號早熟 7 天～ 9 天，且產量表現優異，在農試所歷年之試驗成績（包括品種比較試驗）可超過臺中65號18～20%。由於第二期作在各地之適應性甚佳，臺北、臺中、嘉義、屏東等四處平均產量較臺中65號亦高達10%。農林48號 -A於第二期作似亦有良好之適應性，於48～49兩年第二期作三處平均產量較臺中65號約增加 8 %。

三、以目前全省已推廣之早熟稻以及中、晚熟稻而言，尚缺少產量高而適應性廣之二期作性品種（根據47年第二期作[7]全省蓬萊稻區域適應試驗結果較臺中65號平均產量能增加 5～6 %者全省14個優良品種中僅祇 2 個較晚品種）。將來農林65號 -A或可當作第二期作性品種栽培。此品種之所以早熟而產量高之主要原因，可能由於：(一)因日本晚熟稻對於短日照敏感(感光性强)，在臺灣第二期作（高溫、短日）之環境下，其抽穗雖提早而由[4]晚熟稻（在九州係屬極晚熟稻）方面傳下來之優良性狀仍然存在。(二)對於[5]高溫適應性較强(適應於日本南部九州之高溫地帶)。(三)抽穗開花期較早，遭遇冷害之機會減少。

四、據岡(1954)[1,2]及田口(1959)[3]等之報告可認為本省氣候迄秋季之短日時期(二期作)氣溫高，與栽培二期作性在來種同樣或可利用感光性强（由於高溫可增强榮養生長性，同時有利於與雜草之競爭而較不感光性品種能適應高溫條件）之日本晚熟稻。此外由於本省第二期作稻熱病問題並不嚴重尚可栽培早熟、質優、豐產之日本引進稻。

五、至於其他如農林24號、55號、73號等因成熟過早(較臺中65號提早10天～兩週)，鳥害、鼠害較烈，如無特殊之設備（鐵絲網或絲網設備）較臺中65號早熟一週以上之品種甚難檢定其眞正產量，早熟一週以內之品種則較易（但根據作者在本所及各試驗地田間調查如看鳥、防鼠工作稍有疏忽仍不免受若干之損失）於檢定，因附近田間有比較早植者，可分散鳥、鼠集中為害之故。

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REGIONAL ADAPTABILITY OF NEWLY INTRODUCED RICE VARIETIES IN TAIWAN (PRELIMINARY REPORT)

by

C. W. LIN

SUMMARY

Five newly introduced Japanese varieties and three Ponlai varieties of rice used as controls were planted at Taipei, Taichnng, Chiayi and Pintung, and their adaptabilities to respective localities were tested.

It was found from the field experiment in second crop of 1960, that the average grain yield of Noling No. 48-A in four places showed an increase of 6.2% as compared with Taichung No. 65. Noling No. 73. (One week earlier than Taichung No. 65 in maturity) gave 1.3% higher grain yield than Taichung No. 65 and also 12.9% higher than early maturity varieties of respective places.

Noling No. 65–A showed the highest yield in Taipei, though 7-9 days earlier in maturity than Taichung No. 65. This variety also showed 10% increase in grain yield in Taichung, Chiayi and Pintung, Therefore, it may be recomended for cultivation in the second crop season of Taiwan.

STUDIES ON NUTRIENT ABSORPTION OF RICE PLANTS IN TAIWAN (PART 2)

Nutrient Absorption by Japonica and Indica Varieties of Rice in Relation to Temperature

by

T. F. CHIU, S. LIAN and S. C. HSU

In our previous study[1] we pointed out that high temperatures increased nutrient absorption and plant weights, but it didn't always result in an increase of grain yield. The plants under high temperatures might tend to reinforce vegetative growth at the cost of reducing seed production. It may however be infered that this tendency differ among varieties.

The two variety groups, Japonica and Indica, are both grown in Taiwan while they differ in fertilizer response and its relation to yield. Oka[2] showed that temperature responses could be apportioned into two components, i. e. the rate of growth acceleration due to a rise of temperature and the rate of hastening of flower initiation due to a rise of temperature. The former was generally high in the Indica varieties, while the latter in the Japonica varieties. Oka[3] also pointed out that the fertilizer response was lowered under high temperatures. Indica varieties were found to have a lower fertilizer response and a higher rate of lowering of feritlizer response under high temperatures than Japonica varieties.

The aim of this study is to examine under different temperatures how the two variety groups ditter in the paffern of nutrient absorption and in several agronomic characters.

MATERIALS AND METHODS

A Japonica variety, Taichung no. 65 and an Indica variety, Peh-mi-fen were taken for comparison. The seeds of the genetic stocks preserved in the Institule were used. In the same manner as in 1959, They were grown in two glass-houses keeping different temperatures. Growing status and nutrient absorption were investigated as described in the first report for 1959.

Growth analysis at successive growing stages of the plants were also conducted to know how the two varieties differ in specific growing characters such as relative growth rate, net assimilation rate and leaf area ratio. This is based on the view emphasized by Tsunoda[4] that growing characters of varieties of the same or different crop plants can be comparatively estimated by the growth analysis method. Following this method the dry weight and alive leaf area of plants at successive growing stages are measured and the above-given scores are computed from the data by a certain formula. In this experiment leaf area was measured by printing the shade of alive leaves on

sensitized paper, then cutting the unexposed parts out, the weight of paper was measured to find the leaf area.

RESULTS AND OBSERVATIONS

1. Data for glass-house temperature and measurements of plant characters

The maximum and minimum room temperatures in the two glass-houses were recorded every day. Their average are shown in Table 1 and Fig. 1.

Table 1. Average temperatures

	1st crop, 1960 (Feb. 24-July 12)			2nd crop, 1960 (July 30-Dec. 5)		
	Max.	Min.	Mean	Max.	Min.	Mean
High-temp. glass-house	33.5°C	19.6°C	26.6°C	34.7°C	21.2°C	27.9°C
Low-temp. glass-house	29.7°C	18.6°C	24.2°C	31.0°C	20.0°C	25.5°C
Difference	3.8°C	1.0°C	2.4°C	3.7°C	1.2°C	2.4°C

Culm length, tiller number, plant weight, heading date and other characters were measured at successive growing stages. The results are shown in Table 2 and 3 and Fig. 2.

Table 2. Measurements at maturity

		Taichung no. 65 (Japonica)		Peh-mi-fen (Indica)	
		High-temp. plot	Low-temp. plot	High-temp. plot	Low-temp. plot
1st crop	Culm length (cm)	128.6	120.6	153.6	146.0
	Tiller number	22.0	27.4	24.8	26.6
	Plant weight (g/pot)	105.2	102.3	102.9	97.2
	Grain yield (g/pot)	39.6	40.9	45.6	39.8
	Straw yield (g/pot)	65.6	61.4	57.6	57.4
	Grain/straw ratio	60/100	67/100	79/100	69/100
2nd crop	Culm length (cm)	123.5	124.3	168.3	162.5
	Tiller unmber	21.5	17.9	22.0	21.7
	plant weight (g/pot)	82.9	79.9	102.7	99.3
	Grain yield (g/pot)	36.9	33.5	44.1	40.9
	Straw yield (g/pot)	46.0	46.4	58.6	58.4
	Grain/straw ratio	80/100	72/100	75/100	70/100

Elongation of plant was apparently promoted by the high temperatures, so that the dry matter weight of plants in the high temperature plot was always larger than that in the low temperature plot. This trend was more significant in the first crop than in the second crop.

In the first crop the high temperatures reduced grain yield and grain/straw ratio of Ponlai rice, Taichung no. 65, in the same manner as in 1959. In the second crop such a tendency was not found, however. This might be because of too low temperatures

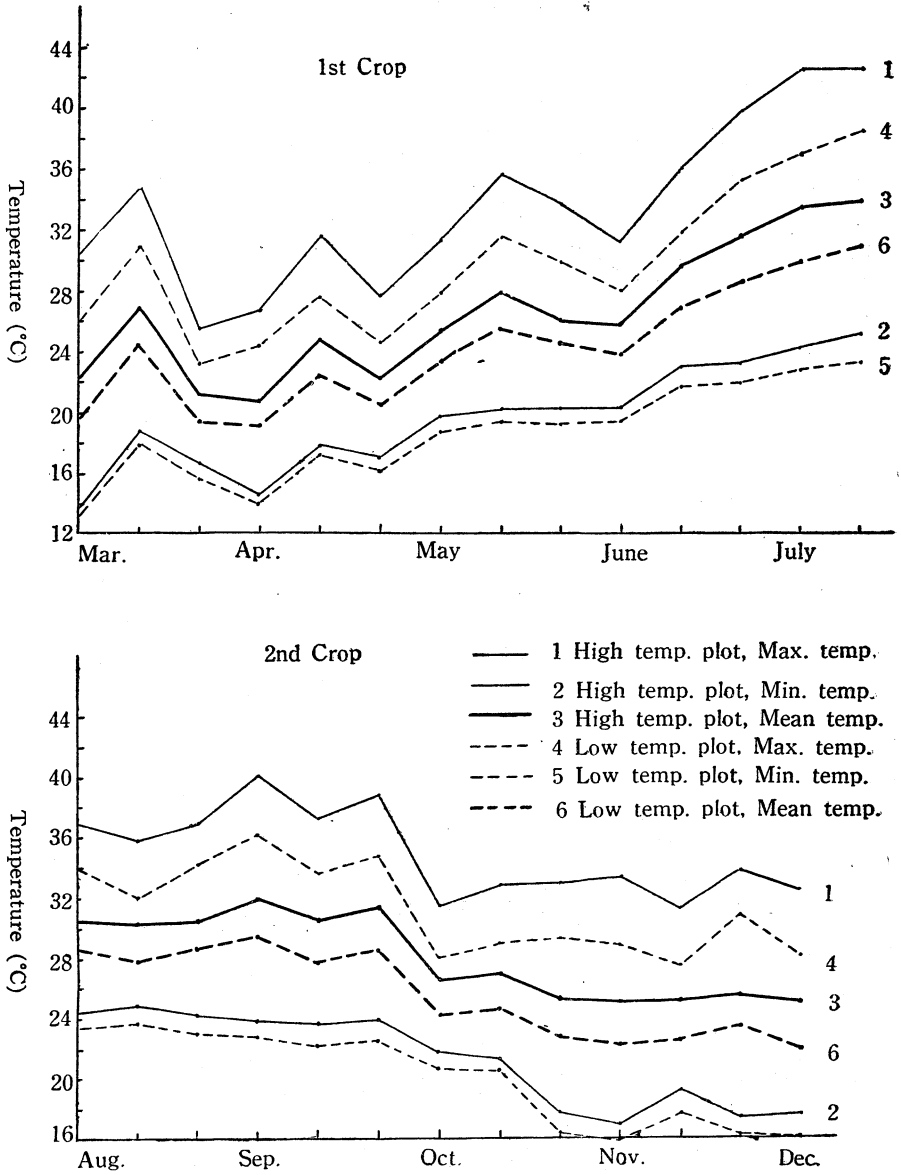

Fig. 1. Change of temperatures in the two glass-houses

after heading of the crop season. It seemed that temperature after heading play an important role in the determing grain yield.

In the native variety, Peh-mi-fen, high temperatures tended to promote grain yield in both the first and second crops. This variety may be more adaptive to high temperature than Taichung no. 65.

Plants in the high temperature plot generally headed earlier than those in the low temperature plot the first crop, but in at the same time in the second crop. The

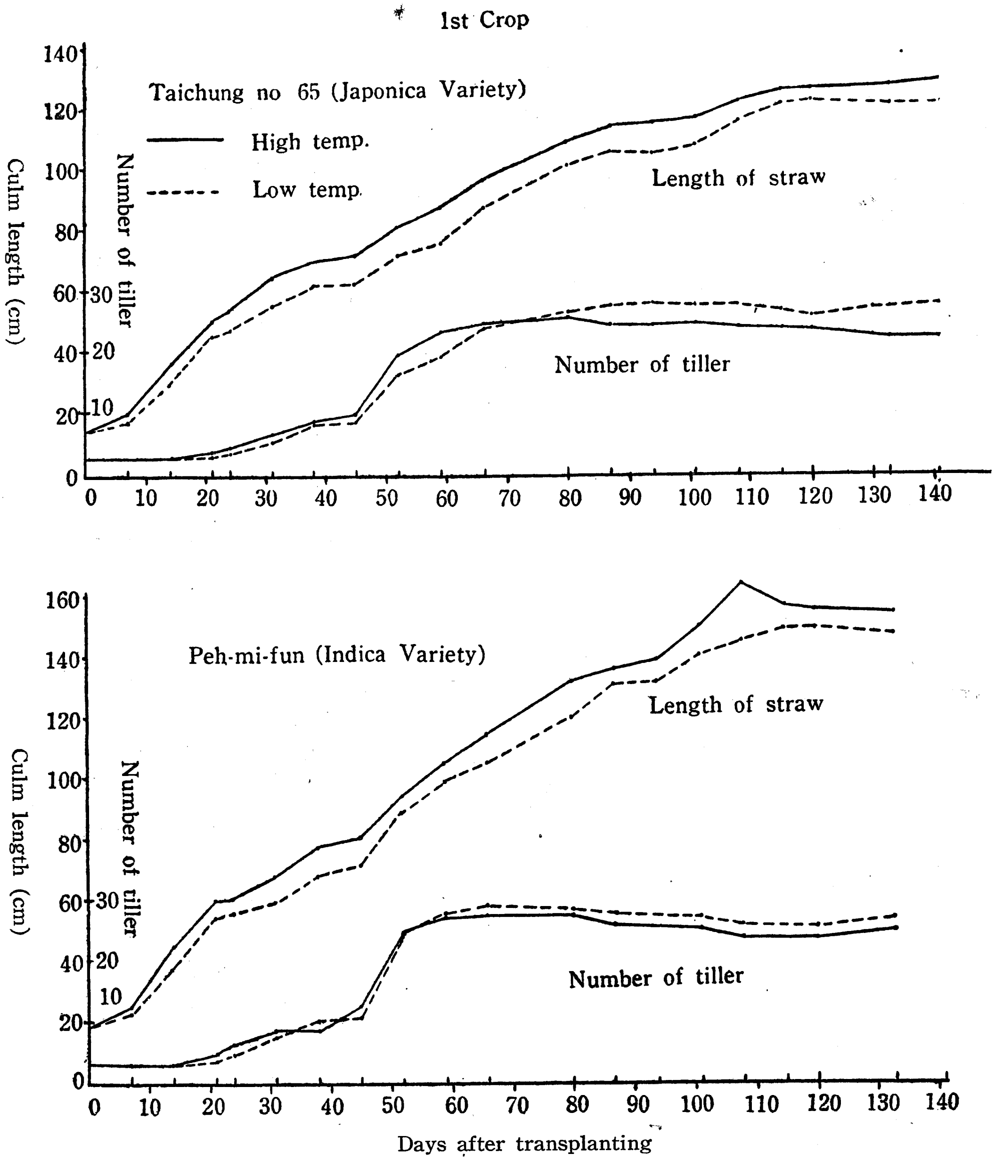

Fig. 2a. Growth status of the plants, 1st crop, 1960

Table 3. Heading date

		1st crop, 1960	2nd crop, 1960
		Heading date	Heading date
Taichung no. 65	High temp. plot	June 8-16	Oct. 17-22
	Low temp. plot	June 16-25	Oct. 17-22
Peh-mi-fen	High temp. plot	June 2-6	Oct. 15-22
	Low temp. plot	June 5-7	Oct. 15-21

2nd Crop

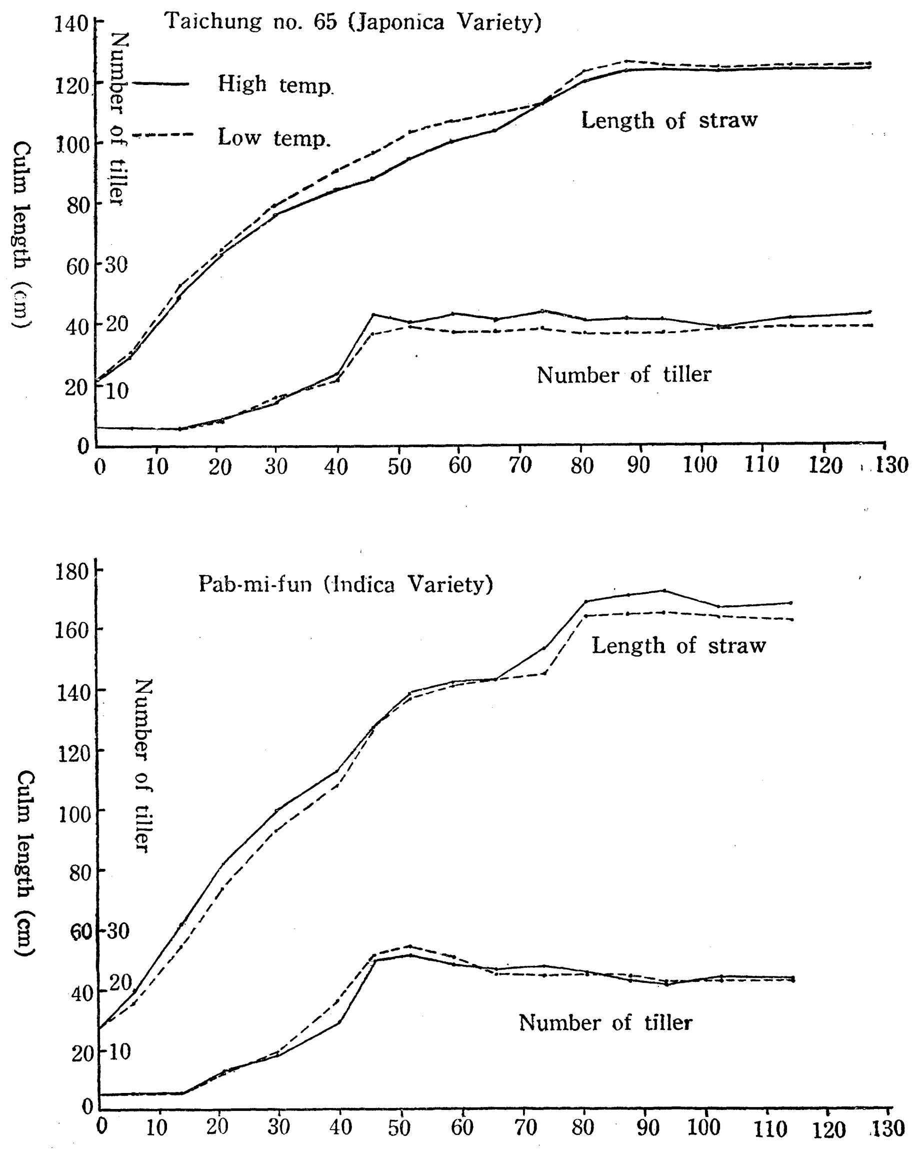

Fig. 2b. Growth status of the plants, 2nd crop, 1960

heading date of Indica variety was generally earlier than that of Japonica variety similarly in the first and second crop.

2. Result of growth analysis

Table 4a. Results of growth analysis at successive growing stages (1st crop, 1960)

Variety	Plot	Date	Days after planting	Dry wt. of plant (g/pot)	Leaf Area dm²/pot	RGR (%) Relative Growth Rate	NAR (mg/dm²/day) Not Assimilation Rate	LAR (dm²/g) Leaf Area Ratio
Japonica	Hightem	Mar. 31	38	1.81	4.08			2.25
		Apr. 14	52	5.25	9.24	7.60*	38.9**	1.76***
		Apr. 28	66	12.70	23.58	6.30	34.7	1.86
		May 12	80	26.35	41.52	5.21	30.7	1.58
		June 2	101	48.4	44.77	2.89	24.4	0.93
		June 21	120	78.8	20.74	2.56	51.2	0.26
		July 12	141	105.2	25.79	1.37	54.1	0.24
	Lowtemp.	Mar. 31	38	1.17	2.79			2.38
		Apr. 14	52	4.48	8.04	9.58	47.6	1.79
		Apr. 28	66	9.81	21.19	5.59	28.0	2.16
		May 12	80	19.23	29.59	4.80	26.7	1.54
		June 2	101	46.2	47.99	4.17	33.7	1.04
		June 21	120	74.3	40.48	2.50	33.4	0.55
		July 12	141	102.3	30.97	1.57	37.5	0.30
Indica	Hightemp.	Mar. 31	38	3.34	7.57			2.27
		Apr. 14	52	9.25	18.83	7.27	34.1	2.04
		Apr. 28	66	19.99	41.93	5.50	26.6	2.10
		May 12	80	40.37	58.75	5.01	29.2	1.46
		June 2	101	76.7	35.37	3.05	37.7	0.46
		June 21	120	101.8	14.74	1.49	55.8	0.14
		July 4	133	102.9	8.37	0.08	7.5	0.08
	Lowtemp.	Mar. 31	36	1.99	3.76			1.89
		Apr. 14	52	8.19	15.32	10.93	53.8	1.55
		Apr. 28	66	17.30	37-92	5.33	26.1	2.19
		May 12	80	34.38	48.44	4.90	28.4	1.41
		June 2	101	56.2	37.79	2.34	24.2	0.67
		June 21	120	93.4	10.81	2.67	90.7	0.12
		July 4	133	97.2	10.45	0.31	27.4	0.11

Example of calculation

* RGA(%)=(loge 5.25g−loge 1.81g)/52day−38 day=0.076 or 7.6%

** NAR=(5.250mg−1.180mg)(loge 9.24dm²−loge 5.25dm²)/(52 day−38 day)(9.24 dm²−5.25dm²) =38.9 mg/dm²/day

*** LAR=9.24dm²/5.25g=1.76dm²/g

Table 4b. Results of growth analysis at successive growing stages (2nd crop, 1960)

Variety	Plot	Date	Days after planting	Dry wt. of plant (g/pot)	Leaf Area dm²/pot	RGR (%) Relative Growth Rate	NAR (mg/dm²/day) Net Assimilation Rate	LAR (dm²/g) Leaf Area Ratio
Japonica	Hightemp.	Aug. 29	30	2.110	4.57			2.17
		Sep. 20	52	12.019	20.00	5.42	29.1	1.67
		Oct. 12	74	39.300	44.88	5.89	44.1	1.14
		Nov. 1	94	62.60	30.89	2.32	30.8	0.49
		Dec. 5	128	82.9	0	0.83	66.5	0
	Lowtemp.	Aug. 29	30	2.130	6.83			3.21
		Sep. 20	52	15.616	25.54	6.23	29.7	1.64
		Oct. 12	74	33.975	64.21	3.81	24.4	1.89
		Nov. 1	94	55.9	24.65	2.49	26.5	0.44
		Dec. 5	128	79.8	0	0.87	91.5	0
Indica	Hightemp.	Aug. 29	30	3.796	9.70			2.56
		Sep. 20	52	24.574	42.82	7.48	37.1	1.74
		Oct. 12	74	54.250	47.97	3.61	30.1	0.88
		Nov. 1	94	86.6	22.12	2.35	48.4	0.26
		Nov. 22	115	102.7	0	0.81	106.8	0

Indica	Lowtemp.	Aug. 29	30	3.959	11.36			2.87
		Sep. 20	52	26.916	54.40	7.66	42.2	2.02
		Oct. 12	74	52.725	55.33	3.06	23.2	1.05
		Nov. 1	94	76.8	13.82	1.66	41.3	0.18
		Nov. 22	115	99.3	0	1.25	108.2	0

Area of living leaves and plant weight were measured at the successive growing stages as shown in Table 4 and "Relative Growth Rate, Net Assimilation Rate, and Leaf Area Ratio" were estimated following the procecdures described in Tsunoda's paper(4). Relative growth rate was high at the early stage, and then decreased gradually till maturity. Net assimlation rate showed two peaks, one peak at the stage before tillering and the other at the ripening stage. It became the lowest about 20 days before heading in the first crop. Leaf area ratio decreased as the plant grew. Although some differences were recognized between varieties and temperature treatments, more intensive studies will beneeded for drawing a conclusion regarding nutrio-physiological differences between varieties.

3. Inorganic nutrient absorption

In the first crop, N and P contents were at the maximum during the seedling stage, and then decreased gradually till harvesting, as shown in Teble 5 and Fig. 3. Since the nursery bed in the first crop were dressed with NPK fertilizers, therfore the values at the transplanting stage might have been higher than in ordinary rice seedlings. Never-hevertheless potassium concentration were still increased after transplanting and reached the maximum at about 40 days after transplanting. It seemed that plants absorbed potassium more rapidly than absorbing other elements at the early stage. In the second crop, N and K contents reached the maximum at about 30 days after transplanting. P contents was the maximum at transplating. Differences of nutrient contents between temperature treatments as well as bbtween varieties were not significant.

The amounts of nutrients absorbed by the plants in the high temperature plot were generally larger than that in the low temperature plot, as shown in Table 6 and Fig. 4. In the Indica variety the increase of nutrient absorption under high temperatures

Table 5a. Inorganic nutrient content (% on oven bry basis) 1st crop, 1960

Variety	Date	High temp. plot			Low temp. plot		
		N%	P_2O_5%	K_2O%	N%	P_2O_5%	K_2O%
Japonica. Taichung no. 65	Feb. 22 (planting)	4.628	2.280	4.464	4.628	2.280	4.464
	Mar. 17	4.324	1.055	5.904	4.660	1.297	5.930
	Mar. 31	4.280	1.075	6.048	4.420	1.010	5.520
	Apr. 14	3.898	1.048	5.222	3.892	1.062	5.356
	Apr. 28	3.803	1.196	5.254	4.278	1.119	4.835
	May 12	2.579	0.866	3.233	3.101	0.862	3.334
	June 2	1.592	0.643	2.155	1.604	0.758	1.818
	June 21	1.207	0.494	1.445	1.251	0.570	1.395
	July 12 (harvesting)	1.086	0.427	1.223	1.039	0.454	1.187

	Grain	1.341	0.610	0.592	1.371	0.581	0.594
	Stem & Sheath	0.630	0.330	1.368	0.609	0.396	1.440
	Leaf Blade	1.564	0.288	2.202	1.338	0.311	1.902
Indica, Peh-mi-fen	Feb. 22 (planting)	4.639	2.160	4.128	4.639	2.160	4.128
	Mar. 17	4.346	1.102	5.856	4.476	1.155	6.144
	Mar. 32	4.492	1.085	6.000	4.422	1.165	6.384
	Apr. 14	3.574	0·950	5.201	3.798	0.999	5.821
	Apr. 28	3·482	0.994	4.239	3.724	0.988	4.630
	May 12	2.448	0.752	2.673	2.254	0.808	2.656
	June 2	1.381	0.485	1.722	1.528	0.650	2.098
	June 21	1.144	0.471	1.370	1.115	0.452	1.314
	July 4 (harvesting)	1.152	0.479	1.302	1.112	0.450	1.269
	Grain	1.591	0.790	0.560	1.532	0.798	0.568
	Stem & Sheath	0.621	0.253	2.060	0.585	0.207	1.886
	Leaf Blade	1.151	0.192	1.572	1.362	0.211	1.401

Table 5b. Inorganic nutrient content (% on oven dry basis) 2nd crop, 1960

Variety	Date	High temp. plot			Low temp. plot		
		N%	P_2O_5%	K_2O%	N%	P_2O_8%	K_2O%
Japonica, Taichung no. 65	July 30 (planting)	3.00	0.846	3.36	3.00	0.846	3.360
	Aug. 29	3.576	0.814	4.903	3.127	0.785	5.238
	Sep. 20	3.146	0.650	3.855	3.121	0.651	3.926
	Oct. 12	2.324	0.739	2.836	2.254	0.712	2.920
	Nov. 1	1.674	0.651	2.072	1.623	0.569	2.030
	Dec. 5 (harvesting)	1.581	0.580	1.730	1.414	0.531	1.707
	Grain	1.69	0.740	0.552	1.65	0.708	0.588
	Stem & Sheath	1.26	0.495	2.808	1.01	0.448	2.628
	Leaf Balde	2.08	0.345	1.730	1.80	0.299	2.244
Indica, Peh-mi-fen	July 30 (planting)	3.31	0.958	3.984	3.31	0.958	3.984
	Aug. 29	3.995	0.659	5.771	3.734	0.471	5.279
	Sep. 20	3.128	0·593	3.715	2.891	0.858	3.142
	Oct. 12	1.672	0.506	2.391	1.591	0.575	2.008
	Nov. 1	1.196	0.484	1.654	1.145	0.543	1.676
	Nov. 22 (harvesting)	1.107	0.411	1 412	0.974	0.425	1.298
	Grain	1.47	0.602	0.576	1.37	0.658	0.600
	Stem & Shoath	0.70	0.279	2.352	0.58	0.270	1.992
	Leaf Blade	1.13	0.244	1.356	0.96	0.243	1.272

Table 6a. Distribution of inorganic nutrients in plants at maturity, 1st crop, 1960

Variety	Plot	Part	N	P_2O_5	K_2O
			mg/pot (Index)	mg/pot (Index)	mg/pot (Index)
Japonica, Taichung no. 65	High temp. plot	Grain	531.0 (47)	241.5 (54)	234.4 (18)
		Stem & Sheath	281.0 (25)	147.2 (33)	610.1 (47)
		Leaf Blade	328.4 (29)	60.5 (13)	442.6 (35)
		Total	1,140.4 (100)	449.2 (100)	1,287.1 (100)
		(Index)	(100)	(39)	(113)
	Low temp. plot	Grain	550.5 (52)	237.6 (51)	242.9 (20)
		Stem & Sheath	258.2 (24)	167.9 (36)	610.6 (50)
		Leaf Blade	254.2 (24)	59.1 (13)	331.4 (30)
		Total	1,062.9 (100)	464.6 (100)	1,214.9 (100)
		(Index)	(100)	(44)	(114)

Indica, Peh-mi-fen	High temp. plot	Grain Stem & Sheath Leaf Blade Total (Index)	725.5 (61) 234.1 (20) 225.6 (19) 1,185.2 (100) (100)	360.2 (73) 95.4 (19) 37.6 (8) 493.2 (100) (42)	255.4 (19) 776.6 (5) 308.1 (23) 1,340.1 (100) (113)
	Low temp. plot	Grain Stem & Sheath Leaf Blade Total (Index)	609.7 (56) 233.4 (22) 238.4 (22) 1,081.5 (100) (100)	317.6 (73) 82.6 (19) 36.9 (8) 137.1 (100) (40)	226.1 (18) 762.5 (62) 245.1 (20) 1,233.7 (100) (114)

Table 6b. Distribution of inoraganic nutrients in plants at maturity, 2nd crop, 1960

Variety	Plot	Part	N	P_2O_5	K_2O
			mg/pot (Index)	mg/pot (Index)	mg/pot (Index)
Japonica, Taichung no. 65	High temp. plot	Grain Stem & Sheath Leaf Blade Totsl (Index)	632.6 (48) 114.2 (32) 273.0 (21) 1,310.8 (100) (100)	273.1 (56) 162.7 (34) 45.3 (9) 481.1 (100) (37)	203.7 (14) 923.1 (64) 307.1 (21) 1,433.9 (100) (109)
	Low temp. plot	Grain Stem & Sheath Leaf Blade Total (Index)	552.1 (49) 329.5 (29) 247.7 (22) 1,129.3 (100) (100)	236.9 (56) 146.2 (34) 41.1 (10) 424.2 (100) (38)	196.7 (14) 857.5 (63) 308.8 (23) 1,363.0 (100) (121)
Indica, Peh-mi-fen	High temp. plot	Grain Stem & Sheath Leaf Blade Total (Index)	647.5 (57) 282.3 (25) 207.1 (18) 1,136.9 (100) (100)	265.2 (63) 112.5 (27) 44.7 (10) 422.4 (100) (37)	253.7 (17) 948.4 (65) 248.5 (17) 1,450.6 (100) (128)
	Low temp. plot	Grain Stem & Sheath Leaf Blade Total (Index)	560.3 (58) 234.8 (24) 171.8 (18) 966.9 (100) (100)	269.1 (64) 109.3 (26) 43.5 (10) 421.9 (100) (44)	253.4 (20) 806.3 (63) 227·7 (18) 1,288.4 (100) (133)

appeared to be followed by an increased transmission of nutrients to grains., but in the Japonica variety, the nutrient transmission to grains did not increase especially in the first crop. Japonica rice seemed to be less adaptive regarding grain formation under high temperatures than Indica rice.

SUMMARY

Agronomic characters and nutrient absorption of a Japonica veriety, Taichung no. 65 and an Indica variety, Peh-mi-fen under different temperature conditions were investigated. Pot experiments were made in two glass-houses with different temperatures, one glass-house with closed and the other with opened windows The former had temparatures 2.4° C higher than the latter on the average for the growing period.

High temperatures promoted straw elongation increase of dry matter weights and the heading date in both varieties. This trend was more signigicant in the first crop than in the second crop.

In Taichung no. 65 high temperatures decreased grain yield and grain/straw ratio so

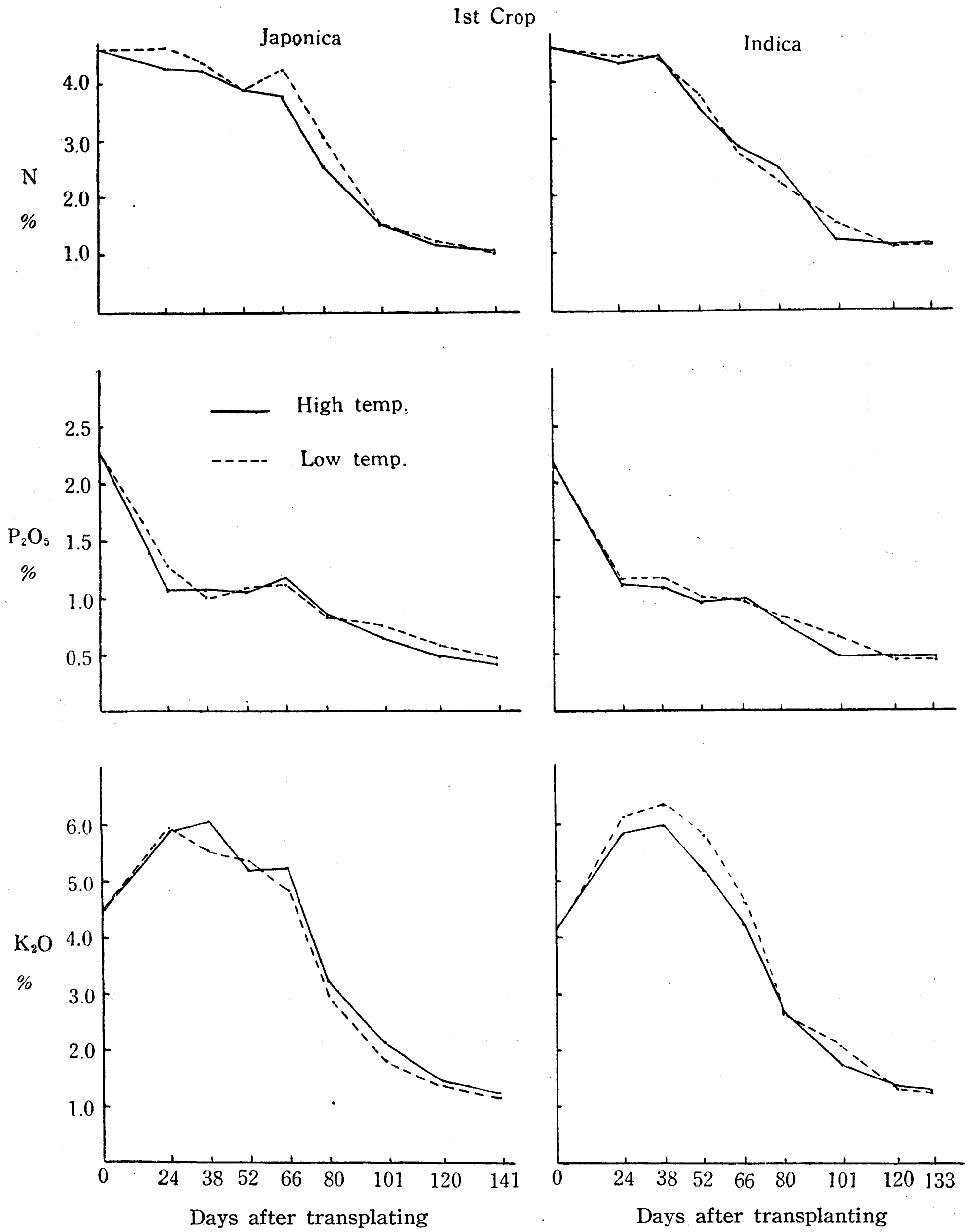

Fig. 3a. Change of nutrient contents in the plants, 1st crop, 1960

far as the first crop is concerned. In Peh-mi-fen, high temperatures tended to increase grain yield and grain/straw ratio.

Differences in nutrient concentrations between temperature treatments and between varieties were not very significant.

High temperatures generally increased nutrient absorption. In the Indica variety

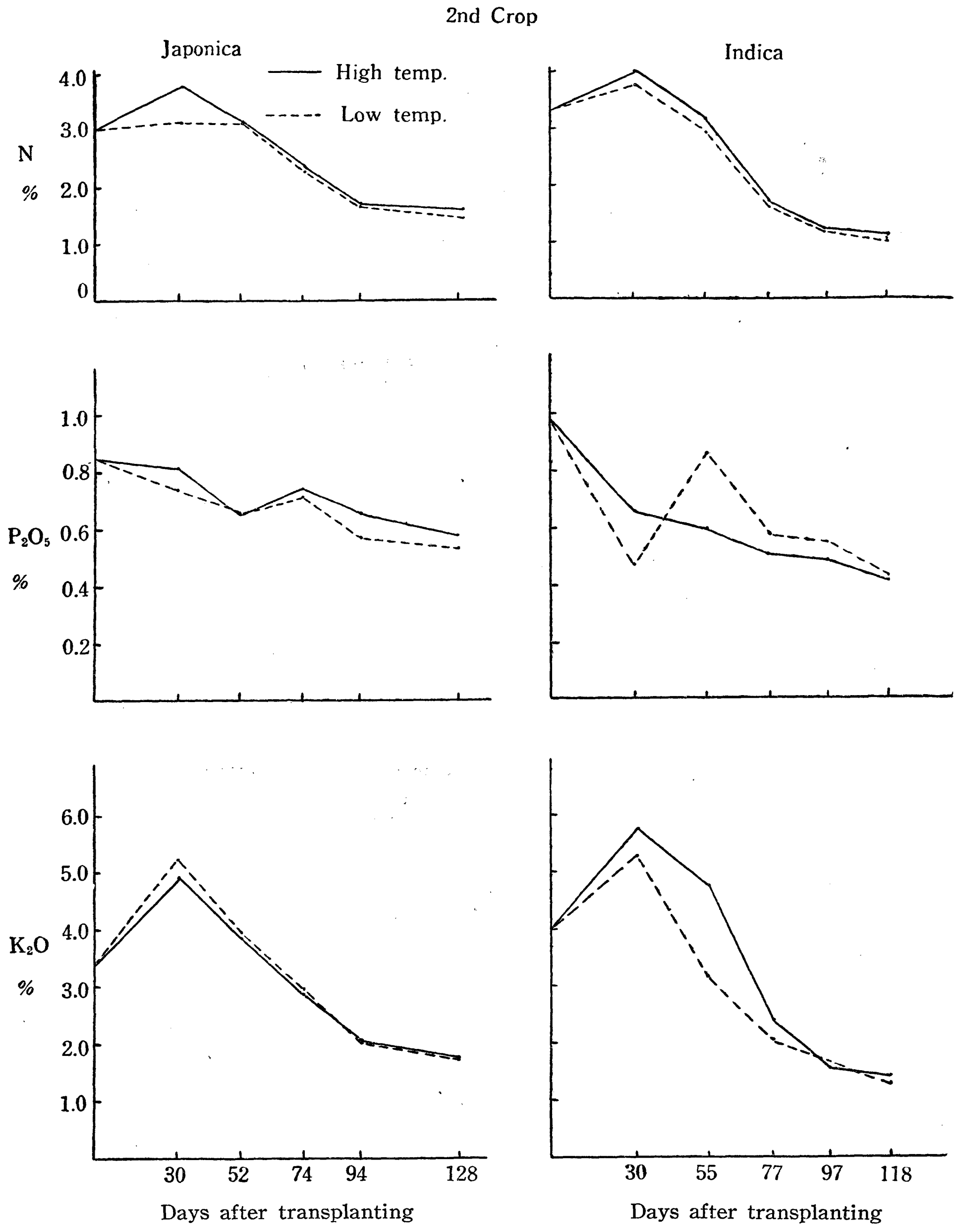

Fig. 3b. Change of nutrient contents in the plants, 2nd crop, 1960

the increasing of nutrient absorption under high temperatures appeared to result in an increased transmission of nutrients to grains. but in the Japonica variety, it didn't always bring abcot an increased nutrient transmission to grains.

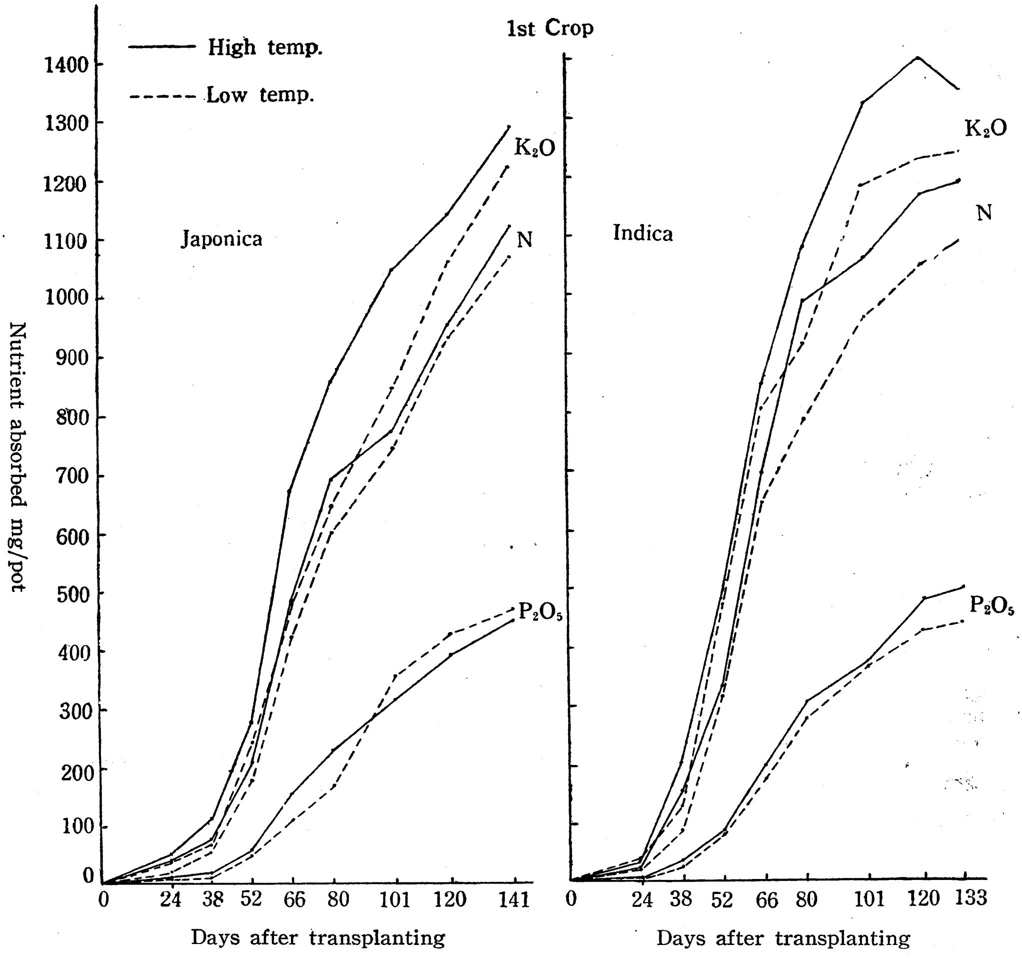

Fig. 4a. Amounts of nutrients absorbed, 1st crop, 1960

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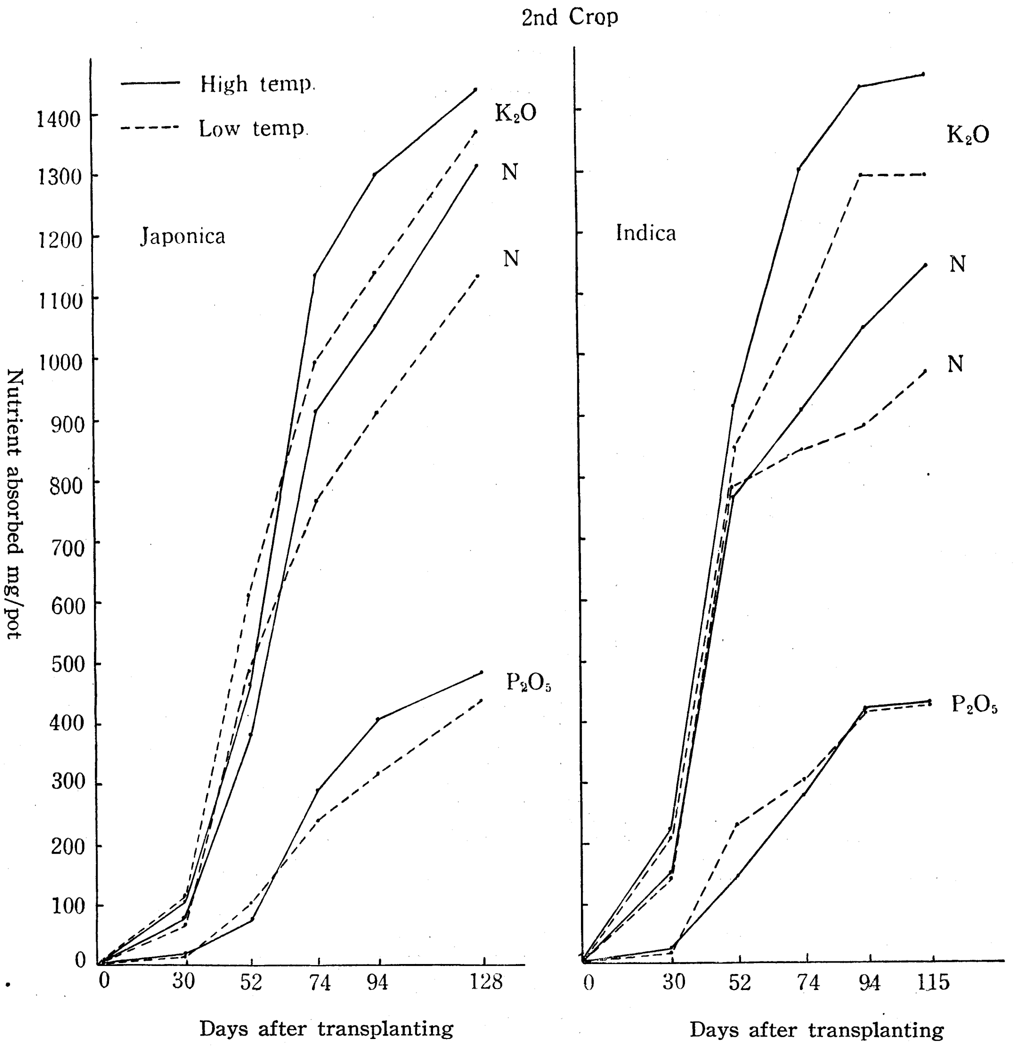

Fig. 4b. Amounts of nutrients absorbed, 2nd crop, 1960

臺灣水稻之養分吸收之研究（第二報）

日本型及印度型水稻之養分吸收與溫度之關係

邱再發　連　深　徐水泉

摘　　要

繼第一報以蓬萊種水稻，臺中65號觀察溫度對養分吸收之影響後，本年度另增在來種水稻，白米粉一種以比較兩品種水稻在不同溫度處理下之養分吸收狀況和生育性狀，結果如下。試驗仍如前報於兩玻璃室內進行，其一係玻璃窗開啓，另一則關閉以做爲比較上之高低溫區。如此水稻生育期

間，高溫區平均溫度可高於低溫區約 2.4°C。

（1） 水稻收穫時之生育狀態及穀藁收量如下表。

收穫調查結果表

		臺中 65 號（日本型）		白米粉（印度型）	
		高溫區	低溫區	高溫區	低溫區
第一期作	株高 (cm)	128.6	120.6	153.6	146.0
	分蘗數	22.0	27.4	24.8	26·6
	總收量 (g/pot)	105.2	102.3	102.9	97.2
	穀 (g/pot)	39.6	40.9	45.6	39.8
	藁 (g/pot)	65.6	61.4	57.6	57.4
	穀/藁比	60/100	67/100	79/100	69/100
第二期作	株高 (cm)	123.5	124.3	168.3	162.5
	分蘗數	21.5	17.9	22.0	21.7
	總收量 (g/pot)	82.9	79.9	102.7	99.3
	穀 (g/pot)	36.9	33.5	44.1	40.9
	藁 (g/pot)	46.0	46.4	58.6	58.4
	穀/藁比	80/100	72/100	75/100	70/100

無論是在來種或是蓬萊種，高溫均促進株高，乾物總收量和出穗。此種傾向以第一期作較第二期作明顯。蓬萊種水稻因第一期作之高溫處理而減低穀產量與穀/藁比率，惟第二期作高溫之效果却反而促其提高。至於在來種則無論第一期作或第二期作穀產量與穀/藁比率均以高溫區較高。由此可知日本型和印度型兩品種在溫度之反應上必有差別。

（2） 本次試驗中，水稻生育各階段之三要素濃度並無溫度處理或不同品種間之明顯差異可察。

（3） 高溫顯然可以促進水稻養分吸收量之增加，惟其移行分布之狀態却在二品種之間稍有差異。蓬萊稻在高溫處理下無機養份總吸收量顯有增加，惟此種多吸收之養分却徒使莖葉部分增加而致使養分在穀實中之相對分布率減低。在來稻則與此稍有不同，其因高溫所促進吸收之無機養分能繼續移行於穀實中，故其養分之相對分布比率不但未見低下，反而有增。此種傾向以第一期作較爲明顯。其收穫時之三要素吸收量如下表：

水稻收穫物三要素總吸收量 (mg/pot)

		高溫區			低溫區		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
第一期作	臺中65號	1,140(100)	449(39)	1,287(113)	1,063(100)	465(44)	1,215(114)
	白米粉	1,185(100)	493(42)	1,340(113)	1,081(100)	437(40)	1,234(114)
第二期作	臺中65號	1,311(100)	481(37)	1,434(109)	1,129(100)	424(38)	1,363(121)
	白米粉	1,137(100)	422(37)	1,451(128)	967(100)	422(44)	1,288(133)

石灰石粉對水稻、紫雲英及大豆之肥效

連　深　溫西濱　林國謙

一、前　　言

關於作物施用石灰的研究，過去海內外學者發表之報告甚多，一般均認爲其肥效顯著。臺灣之酸性土壤施用石灰，根據張守敬，步焱昇二氏所作試驗[1]，亦認爲在大多數情形之下，可以增加水稻之谷藁產量。

石灰施用於水田能增加產量，其原因一般皆歸於 (1) 供給有效性鈣，(2) 減少磷酸之被固定，(3) 分解有機質，供給有效性氮素。張步二氏綜合多處試驗結果，並認爲本省水田以 (3) 之作用最爲重要。

關於石灰促進有機質之分解而增加氨態氮之含量，據三井氏試驗結果[3]，施用 $CaCO_3$ 並無此種效果，即使施用量極高時亦復如是，因其鹼性不及 CaO 故。省農業試驗所在1953～55年間比較生石灰與石灰石粉對於水稻之增產效果[2]亦示後者之肥效不及前者，連續使用後效果始漸顯著。可見石灰石粉之能否在水田使用頗屬疑問。尤有進者，本省過去對水稻以外之作物鮮有石灰試驗之舉行。爲進一步明瞭石灰石粉之肥效，乃就水稻以外增加紫雲英，大豆等作物進行肥效試驗。爰就1958～59年間各地試驗結果報告如下，尙祈農業界先進指正。

二、石灰石粉對水稻之肥效試驗

1.　試驗方法

A.　試驗地點及土壤

表一　試驗地點及土壤

地　　點	土　　壤	土壤質地	pH
臺北縣新莊	砂岩頁岩質冲積土	泥砂質壤土	5.3
桃園埔仔	紅　　壤	粘質壤土	5.1

B.　試驗處理係施用量（分 3 噸與 6 噸）與施用時期（分提早施用與插秧前施用）各兩變級之組合共四種，另設一對照區不施石灰，故總共爲五處理。田間排列方法採用拉丁方（5 × 5），試驗小區面積爲 1/1000 公頃。又提早施用區係於前年度第二期作收刈後施用者，插秧前施用區則於第一期作插秧二週前使用。第二期作時各區不再施用石灰，保持原試驗區劃繼續試驗以觀殘效。

C.　三要素施用量，各處理區每期作均爲80:40:40公斤/公頃以硫酸銨，過磷酸鈣及硫酸鉀加入。石灰石粉係臺灣肥料公司所供給，細度爲 100 mesh 含 $CaCO_3$ 99％。

2.　試驗結果及討論

A.　石灰石粉對水稻生育之影響

石灰石粉在水稻生育初期顯然有抑低株高和分蘖之現象，到生育中期以後各區株高才趨相同。兩處田間試驗均有如斯傾向。爲補充田間試驗並闡明石灰石粉在氮肥不同施量下對水稻之效應所設之盆栽試驗最能表明此種傾向(如表二)。

本試驗經費承農復會補助，並蒙該會朱技正海帆先生賜予指導，作者等謹此誌謝。

表二　石灰石粉對水稻生育之影響盆栽試驗成績

處理別＼調查日期＼項目	插秧後20日	插秧後40日		插秧後65日		插秧後120日	
	株高	株高	分蘗	株高	分蘗	株高	分蘗
無氮對照區 (N_0L_0)	47.0	66.0	14.8	86.5	13.8	115.0	11.0
無氮石灰石粉少量區 (N_0L_1)	44.7	62.3	13.0	90.0	14.8	110.3	12.3
無氮石灰石粉多量區 (N_0L_2)	42.3	57.3	11.0	89.5	15.0	115.3	13.0
施氮對照區 (N_1L_0)	47.5	70.3	21.0	103.0	29.5	127.5	26.3
施氮石灰石粉少量區 (N_1L_1)	38.0	63.0	14.3	104.3	21.0	126.8	17.8
施氮石灰石粉多量區 (N_1L_2)	36.8	61.3	11.3	100.0	21.0	126.0	18.8

上述盆栽試驗係配合田間同時舉行者。所用土壤爲本所農場所採，(爲砂岩頁岩質冲積土，pH：4.7）每盆裝土10公斤。試驗處理係N兩變級（每盆各0克，1克，以硫酸錏供給）與石灰石粉三變級（每盆各0,30，60克）之組合，共六種，四重覆。除試驗處理外，各盆均施 P_2O_5 及 K_2O 各1克。第二期作仍如田間試驗，不再施用石灰石粉以觀殘效。

B. 土壤 pH 值測定結果 (Soil water ratio 1:1)

表三　土壤 pH 值測定結果

處理別＼地點＼測定時期	桃園		新莊	
	施用前	二期作收穫後	施用前	二期作收穫後
對照區（不施石灰石粉）	5.1	5.1	5.3	5.0
3 ton/ha 石灰石粉提前施用區	5.1	5.4	5.3	5.5
3 ton/ha石灰石粉插秧前施用區	5.1	5.5	5.3	5.5
6 ton/ha 石灰石粉提前施用區	5.1	6.3	5.3	6.0
6 ton/ha石灰石粉插秧前施用區	5.1	6.8	5.3	6.0

C. 石灰石粉對水稻收量之影響

表四　田間試驗水稻谷產量比較

處理別＼期作＼試驗地＼產量及指數	第一期作				第二期作			
	新莊		桃園		新莊		桃園	
	谷產量	指數	谷產量	指數	谷產量	指數	谷產量	指數
對照區（不施石灰石粉）	3,290	100	3,416	100	4,002	100	4,741	100
3 ton/ha 石灰石粉提早施用區	3,514	107	3,302	97	4,073	102	4,600	97
3 ton/ha石灰石粉插秧前施用區	3,376	103	3,576	108	4,042	101	4,592	97
6 ton/ha 石灰石粉提早施用區	3,562	108	3,424	100	3,851	96	4,640	98
6 ton/ha石灰石粉插秧前施用區	3,452	105	3,524	107	3,856	96	4,530	96
L. S. D. 5% 1%	N. S.		120 168		N. S.		N. S.	
C. V. (%)	4.2		2.6		3.5		3.4	

表五　田間試驗水稻藁產量比較

處理別 ＼ 期作 / 試驗地 / 產量及指數	第一期作 新莊 藁產量	第一期作 新莊 指數	第一期作 桃園 藁產量	第一期作 桃園 指數	第二期作 新莊 藁產量	第二期作 新莊 指數	第二期作 桃園 藁產量	第二期作 桃園 指數
對照區(不施石灰石粉)	2,124	100	2,784	100	3,710	100	3,570	100
3 ton/ha 石灰石粉提早施用區	2,250	106	2,734	98	3,700	100	3,582	100
3 ton/ha石灰石粉插秧前施用區	2,200	104	2,890	104	3,730	101	3,610	101
6 ton/ha 石灰石粉提早施用區	2,422	114	2,862	103	3,570	96	3,500	98
6 ton/ha石灰石粉插秧前施用區	2,292	108	2,800	101	3,720	100	3,412	96
L. S. D. 5%	164		N. S.		N. S.		N. S.	
L. S. D. 1%	229							
C. V. (%)	5.3		7.4		2.8		3.7	

由表四、五知石灰石粉對水稻之肥效不甚顯著；雖然各石灰施用區之谷藁收量均稍優於對照區，惟差異不過爲 5 %左右。石灰石粉之提早約2～3個月前施用，效果並不優於其在插秧前使用者。又第一期作所施石灰石粉在第二期作亦無殘效表現；此種結果均與一般所料不同，尙待注意。

根據張守敬氏報告，石灰對於水稻增產之效果，似與土壤之肥沃度有關，凡土壤肥沃或施用大量有效性化學肥料（尤其是氮肥）時效果常小；反之凡土壤瘠瘦或僅施緩效性之自給肥料者，其效果甚爲顯著（此時氮爲水稻生長之限制因子）。故石灰對水稻生長之良好作用似以分解有機質，供給有效性氮爲主。惟據三井氏報告，石灰之解放土壤中有效性氮素之能力在其施用後 pH 能一度提高至 8.5 以上者爲顯明，石灰石粉之鹼性較 CaO 或 $Ca(OH)_2$ 低，故無此種效果。以往試驗以及本試驗所示石灰石粉肥效之不顯著，似均可以此解釋。盆栽試驗，不同施氮量下石灰石粉對水稻肥效之差別如下：

表六　盆栽試驗谷產量比較

石灰石粉施用量 g/Pot ＼ 期作 / 氮素施用量	第一期作 0 g/Pot 收量 g/Pot	第一期作 0 g/Pot 與對照區之差 g/Pot	第一期作 1 g/Pot 收量 g/Pot	第一期作 1 g/Pot 與對照區之差 g/Pot	第二期作 0 g/Pot 收量 g/Pot	第二期作 0 g/Pot 與對照區之差 g/Pot	第二期作 1 g/Pot 收量 g/Pot	第二期作 1 g/Pot 與對照區之差 g/Pot
0 (對照區)	14.9		39.9		10.0		25.1	
30	21.5	6.6	21.9	− 14.0**	13.5	3.5	19.9	−5.2*
60	19.7	4.8	31.4	− 4.5	12.0	2.0	23.1	−2.0
L. S. D. 5%		7.9		7.9		3.87		3.87
L. S. D. 1%		11.1		11.1		5.31		5.31
C. V. (%)	18.4				15.0			

表七　盆栽試驗藁產量比較

石灰石粉施用量 g/Pot ＼ 期作 / 氮素施用量	第一期作 0 g/Pot 收量 g/Pot	第一期作 0 g/Pot 與對照區之差 g/Pot	第一期作 1 g/Pot 收量 g/Pot	第一期作 1 g/Pot 與對照區之差 g/Pot	第二期作 0 g/Pot 收量 g/Pot	第二期作 0 g/Pot 與對照區之差 g/Pot	第二期作 1 g/Pot 收量 g/Pot	第二期作 1 g/Pot 與對照區之差 g/Pot
0 (對照區)	19.8		52.3		19.5		63.0	

30	24.9	5.1*	35.7	− 16.6**	19.5	0.0	45.9	− 17.1*
60	24.4	4.6	38.4	− 13.9**	21.6	2.1	43.0	− 20.0**
L. S. D. 5%		4.85		4.85		5.17		5.17
L. S. D. 1%		6.65		6.65		7.08		7.08
C. V. (%)	10.0				9.8			

由表六及七知石灰石粉在施氮 (1gN/Pot) 情形下對水稻谷藁收量非但沒有增產，反而抑低產量。在缺氮之情形下（卽不施氮）才有稍許的正效果。

根據山口氏報告[4]，幼穗形成期之石灰追肥可抑止水稻無效分蘖，增加粒數及千粒重，但石灰之多量基肥卻能抑止分蘖而致使減產。又石灰對水稻的氨態氮素吸收實具有阻止的作用。石灰旣可解放土壤中有機態氮以供水稻利用，另一方面又阻其吸收，此兩相反因子如何影響水稻對氮素之吸收或如何影響水稻之生育和收量，當依土壤肥沃度，施用量以及石灰之施用時期等因素而不同。

在本試驗中，無論盆栽或是田間，石灰石粉施用區之水稻在其生育初期葉色均較對照區稍黃，株高和分蘖亦略低少，尤以盆栽試驗最爲明顯。可見石灰石粉旣無一般石灰之解放土壤有機態氮素之能力反而有抑抵氨態氮素吸收之可能。

在盆栽試驗中，有施硫銨之情形下，鈣對谷藁產量均呈顯著之負效果但在不施硫銨之情形下(卽缺氮)，石灰石粉之施用與不施用在收量間則無顯著之差異，此種結果如以上面現象說明，或許爲施用硫安各區之土壤中氨態氮素濃度較高故水稻吸收時，其所受鈣之影響相對的大所致，惟是否如此屬尚待證實。

三、石粉對紫雲英及大豆之肥效試驗

1. 試驗方法

A. 試驗地點及土壤

表八　試驗地點及土壤

作物	試驗地點	土類	土壤質地	pH
紫雲英	桃園東埔	紅壤	粘質壤土	4.9
大豆	竹北	砂岩頁岩質冲積土	壤土	5.8
	屏東麟洛	粘板岩及砂頁岩質冲積土	泥砂質粘壤土	5.1

B. 田間設計採用隨機區集法五重覆，小區面積爲1/1,000公頃。試驗處理分如下六種。

(1) 對照區　不施石灰石粉及磷鉀

(2) 磷鉀區　施用磷鉀各40 kg/ha

(3) 4噸/公頃　石灰石粉施用區(但不施磷鉀)

(4) 2噸/公頃　石灰石粉＋磷鉀($\frac{P_2O_5}{40}-\frac{K_2O}{40}$ kg/ha) 施用區

(5) 4噸/公頃　〃　〃

(6) 6噸/公頃　〃　〃

磷鉀各以過磷酸鈣及硫酸鉀供之。

C. 各種作物之播種以及其他栽培管理方法均按照一般農家慣例行之。播種時期，紫雲英在11月初係利用水田冬季裏作，屏東大豆（百美豆）爲 10月20日亦爲水田裏作（或稱秋作大豆）。竹北大豆(三國種)則於第一期作水田收穫後之 7 月中旬播種，屬夏作大豆。各地石灰石粉之施用日期均較播種期提前1～2星期。

2. 試驗結果

① 紫雲英

表九　紫雲英收量 (kg) 及 pH 測定結果

處　理　別	鮮態莖葉		子　實		收穫時土壤pH
	產　量	指數	產　量	指數	
(1) 對　照　區	12,600	100	500.8	100	4.7
(2) 磷　鉀　區	16,150	128	503.8	101	5.0
(3) 4 ton/ha 石灰石粉施用區	12,120	96	500.4	100	7.1
(4) 2 ton/ha 石灰石粉+磷鉀施用區	13,940	111	543.8	109	6.2
(5) 4 ton/ha 石灰石粉+磷鉀施用區	15,340	122	481.0	96	6.7
(6) 6 ton/ha 石灰石粉+磷鉀施用區	15,300	122	464.6	93	7.0
L. S. D. 5%	1,540		30.5		
L. S. D. 1%	2,100		41.5		
C. V.	8.2		4.6		

再就本試驗中第 1, 2, 3, 5 處理，卽石灰石粉 (L) 與磷鉀 (PK) 各兩施用平準之因子試驗部分加以試因之再分析測驗 F 值如下：

表十　各種試因之再分析（紫雲英試驗）

試　因	鮮態莖葉收量F值	子實收量F值	理論F值
石灰石粉　L	2.56	1.37	{4.73 9.33
磷鉀　PK	69.00**	0.68	〃
石灰石粉×磷鉀　L×PK	0.22	1.27	〃

就紫雲英莖葉產量觀之，(表九及十)磷鉀之肥效非常顯著，惟石灰石粉之效果却不顯著。石灰石粉與磷鉀之間亦無顯著的連應關係。

至於紫雲英子實產量則磷鉀之效果甚微。反之以 2 ton/ha 石灰石粉施用區為最好。過多之石灰石粉施用又導致不良效果。此種結果顯然與莖葉產量所得者不符而令人費解。是否屬實或有他原因尚待繼續試驗，方可明瞭。

(2) 大豆

表十一大豆收量 (kg) 及 pH 測定 * 結果

處　理　別	竹北 子實 產量	竹北 子實 指數	竹北 鮮態莖葉 產量	竹北 鮮態莖葉 指數	竹北 收穫時土壤pH	屏東 子實 產量	屏東 子實 指數	屏東 收穫時土壤pH
(1) 對　照　區	2,368	100	3,132	100	—	417	100	5.3
(2) 磷　鉀　區	2,448	103	3,440	110	5.4	453	109	5.3
(3) 4 ton/ha 石灰石粉施用區	2,268	96	2,904	93	—	535	128	6.0
(4) 2 ton/ha 石灰石粉+磷鉀區	2,516	106	3,528	113	7.1	387	93	6.0
(5) 4 ton/ha 石灰石粉+磷鉀區	2,436	103	3,620	115	7.3	477	114	6.4
(6) 6 ton/ha 石灰石粉+磷鉀區	2,472	104	3,248	104	7.3	402	96	6.4
L. S. D. 5%	.N.S		431			N. S.		
L. S. D. 1%			588					

如紫雲英，就竹北大豆根莖葉收量第 1,2,3,5 處理所得數據加以試因之再分析，測驗 F 值如下：

表十二　竹北大豆莖葉產量試因再分析

變　　因	鮮態莖葉收量 F 值	理　論　F　值
石　灰　石　粉　L	0.027	{4.75 7.33
磷　鉀　PK	12.03**	
石灰石粉 × 磷鉀 L × PK	1.91	

由表十一及十二知大豆試驗部份，除屏東一地因氣候不良，收量不正常，誤差較大，致使處理間之效果差異無法顯著外，竹北試驗地仍如紫雲英表示磷鉀之效應無論在子實或植物體均屬良好。至於石灰石粉之效果則仍不顯著，石灰石粉與磷鉀之間亦無顯著的連應關係。

四、摘　　要

1. 石灰石粉對水稻之肥效並不甚顯著，雖然其施用區谷，藁產量均稍高於對照區，惟差異不多。第一期作所施石灰石粉在第二期作時並無殘效表現。

2. 石灰石粉對紫雲英及大豆亦無顯著肥效，惟磷鉀則有之。

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EXPERIMENT OF GROUND LIMESTONE ON VARIOUS CROPS

by

S. LIAN, H. P. WEN & K. C. LIN

SUMMARY

Experiment of ground limestone on rice, astragalus, and soybean were carried out during 1958–'59. The results obtained are briefly as follows.

1. The effect of ground limestone on the yield of rice was not very significant; the increase of yield caused by the application was merely about 5%.

2. Ground limestone also showed no significant effect upon the yield of astragalus and soybean. The P–K treatmuts, however, revealed considerably superior effect upon the yield of them.

稻熱病病原生理型之研究

洪 章 訓　簡 錦 忠　林 淑 媛

一、緒　　言

在減少植物病害之對策中，最有效爲預防，預防中最合乎經濟原則者爲育成抗病性品種及其栽培。但於育成抵抗性品種之過程中，首先須明瞭抗病性之本質，再確立抗病性之檢定法。

本省關於稻熱病之研究，自幾年前開始，但一般認爲較爲抗稻熱病之稻品種，近年來在各地栽培後，其抗病情形頗有差異，此中原因究係受各地區及季節氣候因子影響，抑或由稻熱病病原生理之變異，對此點即稻熱病病原菌之系統研究尚缺詳細之探討，實爲從事稻抗病育種工作之先決問題。

本試驗欲探求稻熱病病原是否有生理型存在，種類若干，及分佈情形如何，俾能配合稻作育種及品種推廣。

玆將今年度所得結果列述如下，又此項試驗之經費承蒙中國農村復興委員會補助，得以完成，特此併致謝忱。

二、材料及方法

1. 1959年自臺中、高雄、嘉義、臺北(宜蘭)等地農業改良場所試驗田栽培之水稻品種及本所附近農田雜草，分離培養之稻熱病病菌經單胞分離後，所得菌號共155種，以供試驗。

2. 生理試驗：包括不同溫度(13°, 19°, 25°, 28°, 34°C)，不同酸鹼度（pH 4.5, 5.5, 6.5, 7.5, 8.5）及不同營養（糙米、玉米、高粱、Czapek等培養基），供試菌號選自155菌號在糙米培養基，28°C培養二週呈現不同菌落形態之菌號。

3. 接種試驗：

a. 根據1957年全省性田間觀察及本系人工接種稻熱病菌，品種間反應結果，選出16種水稻品種做爲判別品種。(見後)

b. 在溫室內應用鉛盤培育稻苗，每盤播16品種，利用重氮旱栽，每盤施用硫酸錏水溶液 2 %，500 cc 二次，苗生長約達15公分時，舉行人工接種。

c. 各菌號之病原菌培養於稻穗培養基(500 cc裝三角瓶，稻穗60 g，蔗糖液 2 %20 cc)設換氣裝置，以增殖分生孢子，經 9～10天作成孢子懸浮液，各菌號間之供接種孢子量盡量調製一致，每 4 平方英尺 800 萬～1,000 萬/600 cc。

d. 於暗室內行噴霧接種，每盤罩以玻璃膠帶隔離之，每處理三重覆，前後舉行三次，接種後保持12小時黑暗，並維持相對濕度在95%以上，接種後第 4 天開始調查各品種之感病反應，繼續觀察至第10天，觀察感病反應之標準如下：

(1) S (Susceptible)＝感病性：病斑大型紡錘形或類似的形狀，在病斑中部呈灰白色，內緣呈褐色，外緣呈黃色或黃褐色，但如病斑屬小型其全部色澤呈灰色（即急性病斑）亦屬本型。

(2) M (Intermediate)＝中間性：各種形狀的病斑，該斑僅呈褐色，中央部無或稍帶灰白色。

(3) R (Resistant)＝抗病性：小斑點或小病斑，呈褐色乃至帶黑褐色。

(4) I (No lesion)＝無感病反應：無病斑。

三、試 驗 成 績

1. 不同溫度與稻熱病病原菌之生長比較：

本試驗供試之病原均使用糙米煎汁培養基培養；其配合量爲糙米 200 g，洋菜17g，蔗糖20g，蒸餾水 1000 cc，溫度調節分爲 13, 19, 25, 28 及 34°C等五級，借用臺大植物病理系冷藏室舉行。供試菌種爲 886 菌號採自嘉義分所，自臺中系比33號所分離，891 及 288 菌號採自同所，自 Custug-ulcule 所分離，529 及 1124 菌號採自臺中(東勢)，自光復 1 號所分離，K67 及 111 採自高雄（萬巒），自嘉農 242 號所分離，草 7 菌號於本所自雜草分離所得之病原。每菌號三個重覆，經過十天之培養，然後調查其生育情形，前後三次其平均結果列於表一。

表一 溫度與病原菌生育情形之比較

菌號	生育情形		13°C	19°C	25°C	28°C	34°C
891	菌落	直徑	(mm) 50.3	69.2	75.0	84.0	11.5
		色澤	白色氣生菌絲生長細密	同 左	同 左	白色氣生菌絲較稀疏	同 左
529	菌落	直徑	(mm) 40.5	65.0	73.5	80.0	10.0
		色澤	灰綠色	同 左	同 左	同 左	同 左
886	菌落	直徑	(mm) 42.0	60.5	69.5	84.5	10.7
		色澤	墨綠色氣生菌絲從中央起成放射形生長	同 左	同 左	同 左	同 左
1124	菌落	直徑	(mm) 45.3	63.1	68.9	81.5	10.9
		色澤	灰綠色外圍有一圈白色菌絲寬 5 mm	同 左	同 左	同 左	同 左
288	菌落	直徑	(mm) 44.5	63.3	69.5	83.5	10.9
		色澤	棕灰色氣生菌絲絨毛狀高 1~1.5 mm	同 左	同 左	同 左	同 左
K 67	菌落	直徑	(mm) 43.5	56.9	65.5	82.5	10.9
		色澤	墨綠色	同 左	同 左	同 左	同 左
111	菌落	直徑	(mm) 40.0	56.5	65.5	79.5	9.8
		色澤	墨綠色外圍爲一圈白色菌絲寬10 mm	同 左	同 左	同 左	同 左
草 7	菌落	直徑	(mm) 29.9	46.3	51.0	58.4	5.1
		色澤	中央呈草綠色	同 左	同 左	同 左	同 左

據表一可知各供試菌號均於28°C下生長最優良，高溫34°C或於低溫13°C下之生長均較慢，尤以34°C 下生長最慢 。供試 7 種菌號中以 891 菌號在各種溫度下之生長速度都較快，111 菌號生長較慢，其他菌號之差異不大。又觀察菌落之色澤 ，891 菌號呈白色，於 25°C 以下溫度其氣生菌絲之生長爲細密，但28°C以上者氣生菌絲較爲稀疏，529 菌號之菌落色澤無論任何溫度下均呈灰綠色，886, K67 及 111 菌號之菌落呈墨綠色，886 菌號之氣生菌絲從中央起成放射形生長，111 菌號之菌落外圍呈一圈白色菌絲，1124菌號呈灰綠色，菌落邊緣有一圈白色菌絲，288 菌號呈棕灰色，氣生菌絲呈絨毛狀。

2. 不同 pH 之培養基與稻熱病病原菌之生長比較：

應用 Czapek 氏培養基，pH 之等級分爲 4.5, 5.5, 6.5, 7.5 及 8.5 等五階級，供試菌號與一項相同。在28°C定溫箱經培養十天後觀察其生育情形，每菌號三重覆，前後三次之平均結果列於表二。

表二 培養基 pH 值與生育情形之比較

菌號 \ 生育情形 \ pH 值			4.5	5.5	6.5	7.5	8.5
891	菌落	直徑	(mm) 62×60	58×60	56×58	55×53	50
		色澤	灰白色菌絲生長細密	同 左	同 左	同左但菌絲較稀且粗	同左但氣生菌絲很粗
529	菌落	直徑	(mm) 58	56	53	55×53	45
		色澤	灰綠色	同 左	同 左	同左但菌絲生長較粗	同 左
886	菌落	直徑	(mm) 40×45	48×45	53	50×53	42×40
		色澤	墨綠色中央色深外圍菌絲稀疏	同 左	同左但外圍菌絲生長粗	同 左	同左菌絲生長很粗
1124	直徑	色澤	(mm) 45	50×52	50	50	50
		同左	灰綠色外圍有一圈白色透明菌絲寬50mm	同 左	同 左	同 左	同左但菌絲較粗
288	菌落	直徑	(mm) 50×52	56×60	65	50×55	50
		色澤	棕灰色氣生菌絲，絨毛密生	同 左	同 左	同 左	同 左
K 67	菌落	直徑	(mm) 57×58	56	56×58	55	50
		色澤	墨綠色	同 左	同 左	同左但菌絲生長很粗	同 左
111	菌落	直徑	(mm) 58	45	53×54	40	45
		色澤	墨綠色邊緣不完整，外圍有一圈透明白色菌絲	同 左	同 左	同左但氣生菌絲生長較粗	同左但氣生菌絲生長漸粗

草 7	菌	直徑	(mm) 55×60	45	40	35	20×25
	落	色澤	墨綠色外圍淺但菌絲生長細密	同　左	同左但外圍菌絲生長漸粗	同　左	同左但菌絲生長很粗

按表二，得知 pH 值低時，各菌號之菌絲生長細密，自 pH 6.5 以上各處理區之菌絲漸趨稀而粗。pH 8.5 時各菌號生長緩慢，尤以草 7 菌號爲明顯。又在 pH 4.5 時生長最佳，pH 值漸高其生長不良之菌號有 891, 529, K67, 111, 草 7 等，886 及 288 菌號在 pH 值 6.5 時，1,124 菌號在 pH 值 5.5 時生育較良。

3. 不同營養物質之培養基與稻熱病病原菌之生長比較：

供試培養基種類有糙米煎汁培養基（糙米 200 g；洋菜 17 g；蔗糖 20 g；蒸餾水 1,000cc），高粱煎汁培養基（高粱 200 g；洋菜 17 g；蔗糖 20 g；蒸餾水 1,000 cc），玉米煎汁培養基（玉米 200 g；洋菜 17 g；蔗糖 20 g；蒸餾水 1,000 cc）及 Czapek 氏培養基等四種。每菌號三重覆培養於 28 °C定溫箱，經二週(14天)後觀察其生長情形前後三次，其平均結果列於表三。

表三　不同營養培養基與病原菌生長比較

菌號	生長情形	糙　米	高　粱	玉　米　粉	Czapek
891	菌落直徑（mm）	90×89	90×90	80×90	60×65
	菌落色澤	白　色	白　色	白　色	灰白色但氣生菌絲稀疏
529	菌落直徑（mm）	88×88	85×85	80×85	65×70
	菌落色澤	灰綠色	橄欖色	灰綠色	橄欖色
886	菌落直徑（mm）	75×75	79×79	70×70	60×65
	菌落色澤	墨綠色菌絲由中央起成放射形生長氣生菌絲茂盛高2mm	同　左	灰綠色	墨綠色氣生菌絲生長稀疏
1124	菌落直徑（mm）	85×85	70×80	80×80	60×60
	菌落色澤	灰綠色外圍爲5mm寬之白色菌絲	同　左	同　左	較左爲深色菌絲亦較粗
288	菌落直徑（mm）	80×85	85×89	75×80	65×78
	菌落色澤	棕灰色氣生菌絲密生呈絨毛狀	同　左	淺棕色氣生菌絲不如糙米培養基良好	棕灰色氣生菌絲生長比糙米培養基較稀而粗
K 67	菌落直徑（mm）	80×85	85×85	80×85	62×70
	菌落色澤	墨綠色	同　左	同左氣生菌絲生長較差	同左菌絲較粗
111	菌落直徑（mm）	75×75	75×75	72×75	63×65
	菌落色澤	墨綠色邊緣不完整外圍爲一圈白色菌絲寬10mm	同　左	色澤稍淡外圍白色菌絲寬10～20 mm	墨綠色氣生菌絲較粗

草 7	菌落直徑（mm）	60×60	68×68	60×60	50×50
	菌落色澤	墨綠色年輪狀菌絲生長密外圍白色菌絲寬10～15mm	同　左	同左但外圍白色菌絲寬20mm	同左但外圍白色菌絲寬10～15mm

4. 稻熱病病原菌對水稻鑑別品種之感病反應：

本年度接種供試菌有 529 等七菌號，菌號529, 1124, 1127, 自臺中光復 1 號所分離，菌號1155自臺中嘉農 242 分離，菌號 886 自嘉義臺中系比33號分離，草 2 則自臺北本所附近農田雜草 Oryzae satiua Lin 所分離者。接種期間溫度爲 25°C 左右，每處理三重覆，前後擧行三次接種，所得結果如表四。

表四　幾種稻熱病病原菌號對判別稻種之感病反應

代號	品種名	529	886	891	1124	1127	1155	草 2
1	臺中 65 號	M 1	S 5	M 1	I	S 1	I	I
2	高脚柳州	I	M 3	M 1	I	M 1	I	I
3	崑山五香粳	R 1	S 6	S 3	M 4	S 2	M 1	I
4	高雄大粒清油	I	I	I	I	I	I	I
5	稗稈稻	I	M 1	I	I	I	I	I
6	關東 51 號	I	I	I	I	I	I	I
7	嘉農育280號	I	S 1	I	I	I	I	I
8	臺中 171 號	I	S 1	I	I	I	I	I
9	臺中系比33號	I	S 3	I	I	I	I	I
10	光復 1 號	I	S 4	I	I	I	I	I
11	嘉農 242 號	I	S 1	I	I	I	I	I
12	Cutsugulcle	R 1	S 4	I	I	S 2	I	I
13	臺中低脚烏尖	I	M 1	I	I	SR 2	I	I
14	農林 21 號	I	I	I	I	S 1	I	I
15	Sensho	I	I	I	I	I	I	I
16	Natala	M 1	M 3	I	I	M 1	I	I

根據接種試驗結果，16鑑別品種對菌號間之反應殊有差異，此是否即生理小種之存在，尙待商確。玆按各菌數致病力强弱暫分爲下列五類，而暫未冠以生理型號。

A類：對臺中65號，崑山五香粳，嘉農育 280 號，臺中 171 號，臺中系比33號，光復 1 號，嘉農 242 號，Cutsugulcle 等 8 種顯示感染性病斑，高雄大粒清油，農林21號，Sensho 等三品種顯示無感染，即16判別品種中 8 品種呈感病性病斑， 4 品種呈中間性病斑型， 3 品種呈無感染，因此可以說屬此型菌號之感病能力在供試菌號中最强。…………………………………………886 菌號

B類：對臺中65號，崑山五香粳，Cutsugulcle，農林21號等四品種呈感病性病斑型，臺中低脚烏尖在感病性病斑中混有少數抗病性病斑，此類中特別與A類不同者，即農林21號在A類無感染，於本類中呈感病性病斑型 Natala及高脚柳州與A類相同呈中間性，其餘稻種均無感染。…1127菌號

C類：此類僅感染崑山五香粳一種，又病斑型呈中間性，其他判別稻種皆無感病，可以說供試菌號中感病能力最弱者。……………………………………………………………1124；1155菌號

D類：對崑山五香粳呈感病性，臺中65號及高脚柳州呈中間性，其餘品種均無感染。…891菌號

E類：與D類有顯著之差異者爲崑山五香粳，在D類呈感染性，但本類中呈抗病性，又 Cuts-

ugulcle 亦呈抗病性，Natala 呈中間性，其餘均無感染。……………………………529 菌號

四、討　　　論

欲抑制稻熱病之蔓延，稻作品種必須具有優良之抗病性。但以往在不同地區，不同品種間抗病性之强弱常有差異，此究由於環境因子，稻品種之生理反應，抑或由於病原菌生理小種之存在，因在本省尚未有系統之研究，誠難論斷也。故爲育成良好之抗病品種及其栽培地區之選擇，應先探究病原菌生理分化情形，如能明瞭本省稻熱病菌生理小種之存在，種類與分佈，則對稻熱病防治上之收效將事半功倍矣。

溫度對病原菌之發育具有決定性之影響，溫度不適則病原菌即無法成長爲害。以往有很多報告，大致認爲28°C前後最適於病原菌之發育。末松氏(1916)指出稻熱病菌發育適溫爲 26°～30°C°，西門氏 (1926, 1927) 認爲生長可能溫度 (8～9)～(36～37)°C，發育最適溫爲26°～28°C，澤田氏(1926)報告本菌之發育可能溫度爲10°～37°C，發育最適溫爲 26°～28°C，又末田氏 (1928) 安部氏(1930)吉井氏(1936)等之研究結果與前述者符合。不同系統之病原菌其生長適溫亦有差異，栃內氏(1932)將稻熱病菌按生長適溫分爲二羣，即25°C生長最良者與28°C生長最良者。小西氏(1933)以24種培養系統供試驗觀察結果，按溫度對病原菌之發育之影響分爲三羣，其中有些系統至32°C尚可生長良好，少數系統於36°C仍可繼續生長。栃內氏，島村氏(1932)應用稻藁煎汁培養基，觀察稻熱病之生長狀況結果，有些系統在25°C之生長比28°C差，有些系統則反之，25°C優於28°C，本試驗供試七種菌號均於 28°C下生長最好，菌號間之生長情形有差異，菌號 891 在 19, 25°, 34°C 下之生長速度較其他菌號爲佳，草 7 則在各溫度下之生長均較其他菌號爲差。

關於稻熱病菌在不同 pH 值下之生長，本試驗自 pH 4.5～8.5 病原菌絲均能發育，pH 值低時病原菌絲生長細密，自 pH 6.5 以上各菌號之菌絲生長漸趨稀粗。菌號 891, 529, K67, 111, 草 7，均在 pH 4.5 時生長最佳。逸見氏(1949)曾報告稻熱病菌絲之發育自 pH 4.8～9.7 之範圍內均可生長，而以 pH 5.5 至 8.7 之間之生長較良，pH 4.4 以下，9.7以上之生長極差，至 pH 4.0 及 10.7 時均不能發育。西門氏 (1926) 測定稻葉汁之 pH 值爲 6.0 左右，但人工培養基上其生長範圍則更廣，自 pH 4.3～9.87 均可生長。

病原菌在不同營養培養基上之生長情形，供試菌號除1124菌號外，均於高梁煎汁培養基上之生長最爲優良，其次爲糙米煎汁培養基，玉米培養基再次之，合成培養基 (Czapek 氏培養基) 上之生長最差。各菌號所表現之不同菌落色澤，氣生菌絲生長情形，生長速度等在不同培養基上均很固定。栃內氏(1932)按稻熱病原菌在培養基上之性質區分爲九種生態系，小西氏(1933)利用馬鈴薯煎汁培養基培養稻熱病菌，按其表現之菌落色澤及形態加以歸類。本試驗利用糙米培養基及參照其他培養基上培養結果，按菌落之形態色澤之不同而分爲幾種生態型。

關於稻熱病菌生理型之分類，逸見氏 (1949) 根據稻熱病菌供試菌絲接種於寄主後觀察其病原性之强弱類別爲11羣。1959年日本農林省振興局植物防疫課報告北海道農試場，四菌羣23菌型；長野農試所分爲 3 race 羣，25 races；愛知農試所接種結果分爲18 races，大分農試所分爲5 race 農技研據接種後按病斑型可類別爲 3 race 羣，14 races。鈴木氏 (1953) 按稻熱病菌分生孢子之發芽型，附着器形成型，附着器之形態及在稻體上形成附着器能力等四性質之略呈固定性質，將日本產稻熱病菌類別爲12 Homotype 系統，氏並指出稻熱病菌有 Heterocaryotic 現象之存在，使本項研究趨於複雜化。

本試驗結果，不同菌號之致病力有顯著的差別，16鑑別品種對供試接種菌號之感病反應亦有明顯之差別，自雜草上分離所得之 Piricularia sp 對各水稻品種均無感病反應，但據逸見(1949)報告自雜草 (Panicum Songrinale C.) 上所得之 Piricularia sp 對稻苗葉具有侵害的能力，又鈴

木氏(1953)指出 P. oryzae 菌應用浸漬接種法接種結果，有的菌系統除可浸入稻之外，其他雜草亦呈有侵入之反應。

本年度按各菌號致病力之強弱暫分爲五類，至於究有幾種生理型之存在，此問題目前正繼續在研討中。

五、摘　　要

本試驗欲探求本省稻作稻熱病病原是否有生理型存在，種類若干及分佈情形，而舉行，茲摘出本年度所得結果如下：

1. 供試七種菌號均於28°C下生長最優良，其中 891 菌號在 19, 25 及34°C下均較其他菌號之生長爲佳，各菌號雖均於28°C下生長優良，但在各種溫度下之生長速度有異。
2. 供試七種菌號於 pH 4.5～8.5 之間，菌絲均能發育，但 pH 值較低時菌絲生長較細密，較高時菌絲生長趨稀而且粗。又有些菌號於 pH 6.5 時，有些於 pH 5.5 時生長爲良。
3. 應用植物煎汁培養基培養病原時均比合成培養基之生育爲佳，其中高粱煎汁培養基最優良。
4. 供試七種菌號，應用噴霧接種法，觀察對16判別品種之感病反應頗有差異，本年度按各菌號致病力之強弱暫分爲五類，以明瞭其概況。

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STUDY ON THE PHYSIOLOGICAL RACES OF *Piricularia oryzae* Cav.

by

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SUMMARY

In order to explore the existence of the physiological races of Piricularia oryzae, the rice blast fungus, together with their distribution and kinds, this experiment was carried out.

1. The relation of temperature to the growth of P. oryzae was studied by measuring the colonies' diameter developed on rice-polished agar. The optimum temperature for the growth of the eight isolates having been tested was 28°C. Under same temperature the isolates showed different growing rate. The growth of isolate 891 was better than others at 19°, 25°, and 34°C, but inferior to isolate 886 at 28°C. Isolate G. 7 showed the slowest growth of all isolates.

2. In this studies, the isolates of P. oryzae were cultured at pH 4.5, 5.5, 6.5, 7.5, and 8.5, five grades. Under lower pH. value, the aerial hyphae was well developed, rather minute, and it grew coarser according as the pH value became higher. The optimum pH value of the isolates tested were varied, some at pH 6.5, while others at pH 5.5, or pH 4.5.

3. The growth rate of isolates on four kinds of media displayed the better growth on vegetable decoction media, specifically on Soghum medium, than those on the synthetic medium.

4. Inoculation test held by spraying respectively seven isolates' spore suspention on 16 standard varieties of the rice has shown apprently the different infection types. According to the reaction of rice seedlings, the pathogenicity of the isolates so far tested were primarily classified into five types.

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洪 章 訓　劉 康 鑑

一、緒　　言

本省大豆栽培事業年來由於農藝學者之研究及有關當局之倡導故栽培面積日趨廣大，為配合此項工作著者等曾於四十八年從事大豆病害調查，經獲悉若干病害甚為普遍流行，其中影響產量最大者，首推銹病，復據調查結果，目前在本省各地推廣之品種均遭感染，故於四十八年開始分別在花蓮屏東等地進行藥劑防治試驗，本試驗目的在於檢討供試藥劑之防病效果，適當撒藥時期及防治處理與大豆產量之影響。本試驗承蒙農復會惠予資助，使此項工作得能順利完成。本文先就花蓮區試驗結果作分析討論，試驗期中荷蒙花蓮區農業改良場許兩順先生鼎力協助，於此謹誌　謝忱。

二、材料及方法

1. 材料：

供試之大豆品種為三國種，藥劑則以硫黃類及含銅藥劑為主。

表一：試驗期別供試藥劑種類及濃度

供試藥劑	四十八年秋作	四十九年春作	四十九年秋作
Dithane Z-78	300 gr/100 *l*	300 gr/100 *l*	300 gr/100 *l*
Dithane M-22	——	300 gr/100 *l*	300 gr/100 *l*
0-3818-B	200 gr/100 *l*	50 gr/100 *l*	——
6-6 Bordeaux Mixture	6-6-1,000	6-6-1,000	6-6-1,000
3-3 Bordeaux Mixture	——	——	3-3-1,000
Dithane Z-78 Plus	300 gr/100 *l* Plus	——	——
Wettable Sulfur	600 gr	——	——

2. 方法：

A. 藥劑撒佈：

藥劑撒佈時期按大豆播種後之日數分為生長前期中期，中後期，後期，每期撒藥各五次，每隔一星期撒佈一次，另設不定期撒藥區於發現罹病時開始撒藥至顯有防病效果時為止，不限撒佈次數但噴藥日期之間隔仍以七天撒佈一次。此外設無撒佈區為對照。

表二　播種後日次撒藥起訖日次表

撒藥期＼播種後日次	28	35	42	49	56	63	70	77
前期撒藥	×	×	×	×	×			
中期撒藥		×	×	×	×	×		
中後期撒藥			×	×	×	×	×	
後期撒藥				×	×	×	×	×

B. 田間設計：

田間採取逢機排列，四重復，每小區面積爲 4×2.5公尺（10m²），每小區一處理（包括一種藥劑一種撒藥期）田間管理與常法同，在適當防蟲時期撒佈安特靈乳劑八百倍。

C. 病斑調查方法：

每期藥劑撒佈全部完畢後，防病效果明鮮時調查，每小區隨機採取五十葉，調查登記每葉在2 cm直徑圓內面積之病斑數目之多寡分爲被害程度六級。其標準爲“0” 無病斑，“1” 1–10個病斑，“2” 11–30個病斑，“3” 31–50個病斑，“4” 51–100個病斑，“5” 101個以上病斑。

求被害程度則按照下列公式：

$$\text{被害程度}=\frac{(0\times A^{*})+(1\times B)+(2\times C)+(3\times D)+(4\times E)+(5\times F)}{\text{調　查　葉　數}}$$

* A. B. C.……等表示該級病葉之葉數

D. 產量調查：

各處理大豆收割後分別乾燥，脫粒，權衡各區之產量並記載。

三、試 驗 結 果

表三　四十八年秋作大豆銹病藥劑防治試效果調查

藥　　劑	撒藥期別	被害程度*	每小區產量(公分)**	藥　　劑	撒藥期別	被害程度*	每小區產量(公分)**
Dithane Z-78	前	1.855	147.5	0-3818-B	前	1.415	166.25
	中	1.800	155.0		中	1.060	143.75
	中後	1.160	163.75		中後	1.540	155.0
	後	1.165	150.0		後	1.110	126.25
Dithane Z-78 Wettable Sulfur	前	1.990	142.5	6-6 Bordeaux Mixture	前	2.070	153.75
	中	1.195	138.75		中	1.8625	145.0
	中後	2.670	173.75		中後	2.095	147.5
	後	1.285	165.0		後	2.700	118.75
Dithane Z-78	不定期	1.660	166.25	CK (Non-Control)		3.050	112.5

※平均值差異最低標準值 *5％=0.206　1％=0.268　**F值不顯著。

表四　四十九年春作大豆銹病藥劑防治試驗效果調查

藥　　劑	撒藥期別	被害程度*	每小區產量(公分)**	藥　　劑	撒藥期別	被害程度*	每小區產量(公分)**
Dithane Z-78	前	3.64	723.8	0-3818-B	前	3.79	498.8
	中	1.42	938.8		中	3.20	612.5
	中後	1.05	940.3		中後	3.05	585.0
	後	1.29	915.5		後	3.03	578.8
Dithane M-22	前	3.77	761.3	6-6 Bordeaux Mixture	前	4.30	478.0
	中	1.15	1,032.5		中	3.40	653.0
	中後	1.14	1,018.5		中後	3.38	695.0
	後	1.51	1,195.8		後	3.40	547.0
Dithane Z-78	不定期	1.25	1,029.3	CK (Non-Control)		4.43	317.5

※平均值差異最低標準值 *5％=0.32　1％=0.43　**5％=49.02　1％=58.20

表五　四十九年夏作大豆銹病藥劑防治試驗效果調查

藥劑	撒藥期別	被害程度*	每小區產量（公分）**	藥劑	撒藥期別	被害程度*	每小區產量（公分）**
Dithane Z-78	前	4.09	885.5	3-3 Bordeaux Mixture	前	4.015	910
	中	4.07	1,030.0		中	3.95	1,010
	中後	4.205	1,223.0		中後	4.075	1,150
	後	3.845	1,395.25		後	3.905	1,255
Dithane M-22	前	4.085	1,015.0	6-6 Bordeaux Mixture	前	3.915	899.5
	中	4.10	1,027.5		中	3.945	892.0
	中後	4.215	1,235.0		中後	3.895	1,013.25
	後	3.665	1,470.0		後	3.82	1,236.75
Dithane Z-78	不定期	3.385	1,371.5	CK (Non-Control)		4.06	937.5

※平均值差異最低標準值 * 5％＝0.1125　1％＝0.1479　** 5％＝144.84　1％＝190.37

四、試驗結果之統計分析

試驗結果以複因子試驗分析檢討藥劑間之效果差異及葯劑撒佈期間之差異顯着性如表六、七

表六　藥劑撒佈期間防病效果差異及顯著性

A. 病斑：

四十八年秋作

處理	被害程度	差異	平均估差異最低標準值
中後期撒佈	1.86625		**1％＝0.0868112
前期撒佈	1.8325	0.03375	*5％＝0.065856
後期撒佈	1.565	0.301**　0.2675**	
中期撒佈	1.479	0.38725**　0.3535**　0.086*	

四十九年春作

處理	被害程度	差異	平均估差異最低標準值
前期撒佈	3.86		
中期撒佈	2.29	1.57**	**1％＝0.1237
中後期撒佈	2.24	1.62**　0.05	*5％＝0.104
後期撒佈	2.15	1.71**　0.14**　0.09	

四十九年夏作

處理	被害程度	差異	平均估差異最低標準值
中後期撒佈	4.098		**1％＝0.0683
前期撒佈	4.027	0.071**	*5％＝0.0519
中期撒佈	4.016	0.082**　0.011	
後期撒佈	3.815	0.273**　0.212**　0.201**	

B. 產量：

四十八年秋作

處　理	產量 (10 m²)克	差　異	平均值差異最低標準值
中後期撒佈	160		F值不顯著
前期撒佈	152.5	7.5	
中期撒佈	145.6	14.4　6.9	
後期撒佈	140.0	20.0 12.5 5.6	

四十九年春作

處　理	產量 (10 m²)克	差　異	平均值差異最低標準值
中期撒佈	820.6		**1%=108.16
中後期撒佈	808.4	12.2	*5%= 91.14
後期撒佈	794.1	26.5　14.3	
前期撒佈	615.7	204.9** 192.7** 178.4**	

四十九年夏作

處　理	產量 (10 m²)克	差　異	平均值差異最低標準值
後期撒佈	1,339.25		
中後期撒佈	1,115.3	183.95**	**1%=98.403
中期撒佈	989.9	349.35** 125.4**	*5%=74.842
前期撒佈	927.5	411.75** 227.8** 62.4	

表七　藥劑間防病效果差異及顯著性

A. 病斑：

四十八年秋作

處　理	被害程度	差　異	平均值差異最低標準值
6-6 Bordeaux	2.182		**1%=0.0868112
Dithane Z-78+W.S.	1.785	0.397**	*5%=0.065856
Dithane Z-78	1.495	0.687** 0.29**	
0-3818-B	1.281	0.901** 0.504** 0.214**	

四十九年春作

處　理	被害程度	差　異	平均值差異最低標準值
6-6 Bordeaux	3.615		**1%=0.137
0-3818-B	3.206	0.409**	*5%=0.104
Dithane M-22	1.881	1.734** 1.325**	
Dithane Z-78	1.845	1.770** 1.361** 0.031	

四十九年夏作

處　　理	被害程度	差　　異	平均值差異最低標準值
Dithane Z-78	4.053		**1%=0.0683
Dithane M-22	4.023	0.030	*5%=0.0519
3-3 Bordeaux	3.986	0.067*　0.037	
6-6 Bordeaux	3.894	0.159**　0.129**　0.092**	

B. 產量：

四十八年秋作

處　　理	產　量 公分(10 m²)	差　　異	平均值差異最低標準值
Dithane Z-78+W. S.	155.0		F值不顯著
Dithane Z-78	154.1	0.9	
0-3818-B	147.8	7.2　6.3	
6-6 Bordeaux	141.3	13.7　12.8　6.5	

四十九年春作

處　　理	產　量 公分(10 m²)	差　　異	平均值差異最低標準值
Dithane M-22	1,000.75		**1%=119.784
Dithane Z-78	890.56	110.19**	*5%= 91.14
6-6 Bordeaux	593.81	406.94**　296.75**	
0-3818-B	553.75	447.00**　366.81**　40.56	

四十九年夏作

處　　理	產　量 公分(10 m²)	差　　異	平均值差異最低標準值
Dithane M-22	1,186.9		**1%=98.4
Dithane Z-78	1,133.4	53.5	*5%=74.9
3-3 Bordeaux	1,081.3	105.6**　52.1	
6-6 Bordeaux	1,010.4	176.5**　123.0**　70.9	

五、討論及結論

據本試驗結果所有之供試藥劑均有顯著防治大豆銹病之效果，其中以 Dithane M-22為最優、撒藥後不但病斑數目減少，且能增加產量其效果實有凌駕他種藥劑之勢，Dithane Z-78 次之，Dithane Z-78 混合可濕性硫磺粉劑再次之，波爾多液又次之，0-3818-B 其用量爲 200 grams/100 liters 時確有防治銹病之效，惟易誘致藥害是其缺點，如藥量減少則藥害固可以減輕，但防病效果亦較差。

本試驗擬定之撒藥開始日期，施藥後之效果均較對照區爲優，惟效果顯著情形常因大豆栽培時期顯有不同。如春作大豆，適當之撒藥開始時期應以生長中期爲優，中後期次之，中期更次之，前期撒藥之效果最差，由此可知大豆銹病發生時期各有不同，春作發病早，秋作則較遲，夏作大豆則

以生長後期撒藥之效果爲最優，中後期次之，中期更次之，前期之效果最遜，至於秋作大豆亦以生長後期開始撒藥最爲理想，春作及夏作大豆撒藥後其產量顯有增加，秋作大豆撒藥後雖能表現其防病效果，但秋豆因氣候因子左右產量故未見有顯著之增產效果。

在實際應用上，DithaneM-22 或 Dithane Z-78 其用量爲 300 grams/100 liter 兩者均可擇一採用，每期大豆栽培期中應撒藥五次，每次間隔一週。

SOYBEAN SPRAYING EXPERIMENT FOR RUST DISEASE CONTROL

by

C. H. HUNG, K. C. LIU

SUMMARY

Soybean rust caused by *Phakopsora Pachyrhizi* SYDOW is one of the destructive disease found throughout the growing areas. A spraying experiment for the disease control was conducted at Hwa Lien Experiment Station from 1959 to 1960 including three crops of soybean i.e. fall, spring and summer.

The purpose of the experiment is to determine the possible control with fungicides and their effectiveness as well as the timing of spray.

The fungicides used for this experiment were Dithane M-22, Dithane Z-78, Dithane Z-78 plus Wettable sulfur, 0-3818-B and Bordeaux mixture which were applied at 7 days interval. A total of 5 applications of each testing fungicides were taken during the growing period. The first application varied differently wih the number of days after planting; they were the 28th, 35th, 42th, and 49th respectively. Evidences indicated that the disease was well checked by either one of the fungidide which has been tested. The profitable time of the first spraying to control rust disease depended upon different crop of soybean. For protection of the spring crop, the first spraying should be initiated at the 35th day, but it is advisable to initiate the spraying program at the 49th day for both summer and fall crops. Yields of the crop were prominently increased except the fall crop which was insignificant because the weather was the limitting factor upon yields.

Among the testing fungicides, Dithane M-22 showed best effect to control rust disease while Dithane Z-78, Dithane Z-78 plus Wettable sulfur, Bordeaux mixture came next in order. 0-3818-B a new fungicide produced by Rohm & Haas Co., at the rate of 200 grams per 100 liters has its advantage of rust control, but it produced chemical injuries to the leaves after application. The phytotoxicity tended more serious as the rate of the chemical increased. For the best control soybean rust, it is suggested to apply either Dithane M-22 or Dithane Z-78 at the rate of 300 grams per 100 liters of water.

IDENTIFICATION, SEASONAL POPULATION AND CHEMICAL CONTROL OF CITRUS APHIDS OF TAIWAN

by

C. C. TAO & M F. TAN

Citrus virus "Tristeza" has been discovered and its damage is so badly over this island. The transmission methods have been proved by grafting diseased scion from uncertified mother tree and insect vector "aphids.". Therfore the administration of healthy mother tree (free of tristeza) and citrus aphid control being ranked two important works for reducing tristeza damage.

The following results were obtained from past two years (1959–60) observation. The writers wish to express their hearty thanks to Dr. Ting-wei Lew and T. T. Lo of Joint Commision on Rural Reconstruction and Dr. S. C. Hsu, Director of Taiwan Agricultural Research Institute for approving and supervising this study, without them the present paper would not be completed.

I. CITRUS APHID IDENTIFICATION

There are seven species of citrus aphids recorded from this island. They may be separated by the following key.

1. Key to species of Citrus aphids (Figs. 1–8)

1. Frontal tubercles very developed. Siphunculi more or less swollen. Body brown or green . . . . 2.
   Frontal tubercles present but not very developed. Siphunculi cylindrical, never swollen . . . . 3.
2. Frontal tubercles diverging, smooth. Third antennal segment of aptera with one or two rhinariae near the base. Siphunculi as long as the cauda, smooth, scarcely imbricated on the distal half, with some striae near the flange. Cauda slightly constricted at basal one-third, long and stout, acuminate, apex rounded, with five to nine lateral hairs. Body shining brown. Occasionally on Citrus. . . . . *Sinomegoura citricola* (van der Goot)
   Frontal tubercles converging, inward on mesal side, spinulose. Third antennal segment of aptera without rhinaria. Siphunculus is much longer than cauda, cylindrical or swollen at apical third. Cauda somewhat constricted at or near middle and acuminate at apex, with three lateral hairs. Abdomen with a large more or less solid black patch. Body green, light pink or pale. Occasionally on Citrus . . . . *Myzus persicae* (Sulzer)
3. With a stridulating mechanism which consisting of a row short hairs on the

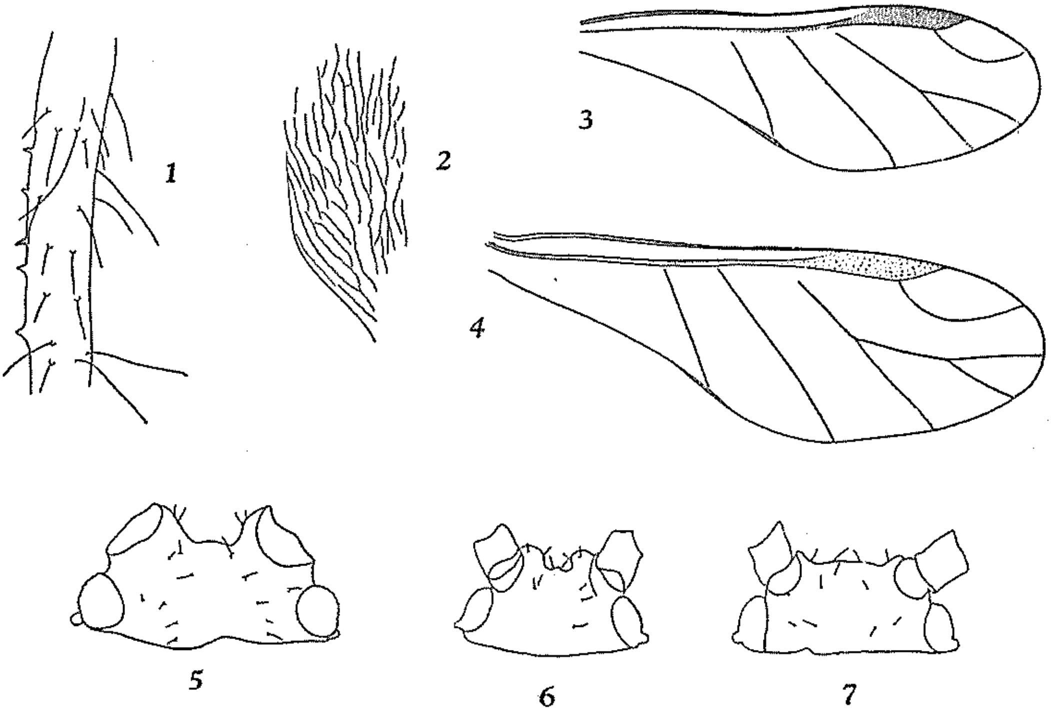

Fig. 1. 1. Part of hind tibia, 2. Part of abdomen of *Toxoptera citricidus*, showing the stridulating mechanism, 3. Fore wing of *T. aurantii*, 4. Fore wing of *T. citricidus*, 5, 6, 7, Head of *Sinomegoura citricola* (without first antennal segment), *Myzus persicae*, *T. citricidus* (with first antennal segment).

hind tibia and a latero-ventral abdominal pattern of raised and serrated cuticle on sternites 5 and 6. Body brown or black.................................. 4.
Without a stridulating mechnism. Body greenish yellow or gray.............. 6.

4. Antennal hairs prominent and a little longer than its diameter of the segment. Siphunculus is much shorter than cauda and nearly as long as the base of sixth antennal segment. Body brown. Very rarely on Citrus........................ .... *Toxoptera odinae* (van der Goot)
Antennal hairs are shorter than its diameter of the segment. Siphunculus is at least longer than the base of sixth antennal segment. Body shining black.... 5.

5. Body comparatively small. Third antennal segment of alate pale except at the very apex and having 2 to 8 rhinariae, arranged in a single row and extending to the whole length, fourth segment without rhinaria. Media of forewing once branched ....*Toxoptera aurantii* (Boyer)
Body comparatively large. Third antennal segment of alate black, except for the very base and bearing 7 to 24 rhinariae, fourth segment with 0–9 rhinariae, the rhinariae are not arranged in a single row and irregularly extended to the most area except both ends. Media of fore wing twice branched..................... ....*Toxoptera citricidus* (Kirkaldy)

6. Fourth antennal segment of alate somewhat with 0–4 rhinariae. Cauda with more than 3 lateral hairs. Body greenish yellow. Usually living within curl leaves..*Aphis spiraecola* Patch

Fourth antennal segment of alate without rhinaria. Cauda usually with 3 lateral hairs. Body gray. Living on opened leaves ....*Aphis gossypii* Glover

2. Notes on Citrus aphids

(1) *Sinomegoura citricola* (van der Goot, 1917) (Fig. 2)

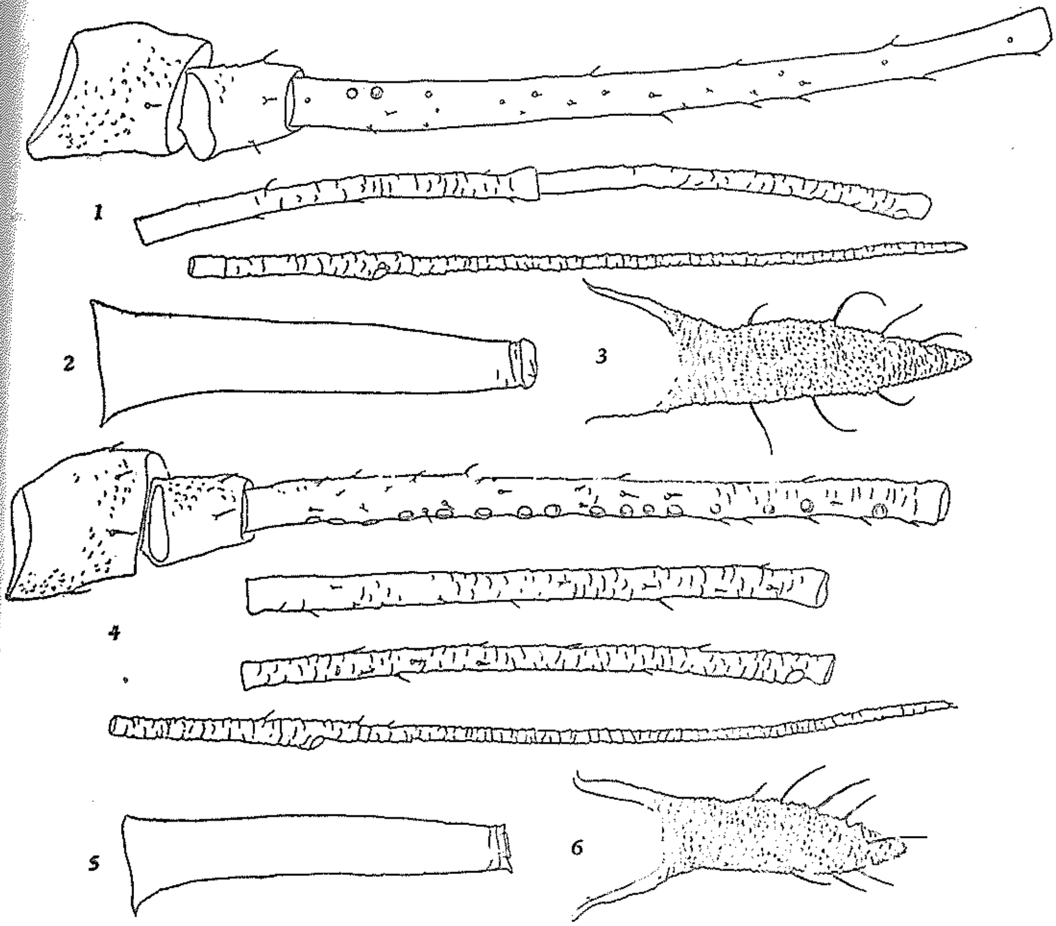

Fig. 2. *Sinomegoura citricola* (van der Goot)
1. 2. 3. Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Macrosiphoniella citricola* van der Goot, 1917; *Tuberosiphum camphorae* Shinji, 1922; *Megoura jacobsoni* Mason, 1927.

Hosts: Burseraceae: *Canarium album;* Camelliacceae: *Camellia japonica;* Caesalpiniaceae: *Bauhinia variegata;* Euphorbiaceae: *Bridelia ovata;* Lauraceae: *Cin-*

namomum champhora, Litsea sp.; Moraceae: *Ficus obscura;* Palmae: *Trachycarpus excilsus;*Rubiaceae: *Lasianthus* sp.; Rutaceae: *Acronychia pedunculata, Citrus* spp., *Murraya exotica.*

This species is first recorded on *Citrus* spp. from this island, but the infestation is not so severe as *Toxoptera* spp. or *Aphis* spp. and whether tranmission tristeza or not is waiting for test. Dr. Takahashi first recorded and it was taken on Citrus from Taitung on May 16, 1935 but he did not publish it yet. This species is very common on *Murraya exotica* in winter and spring near Taipei.

Distribution: China: Taiwan, Kwangtung, and Fuckien; Japan and Java.

(2) *Myzus persicae* Sulzer 1776 (Fig. 3)

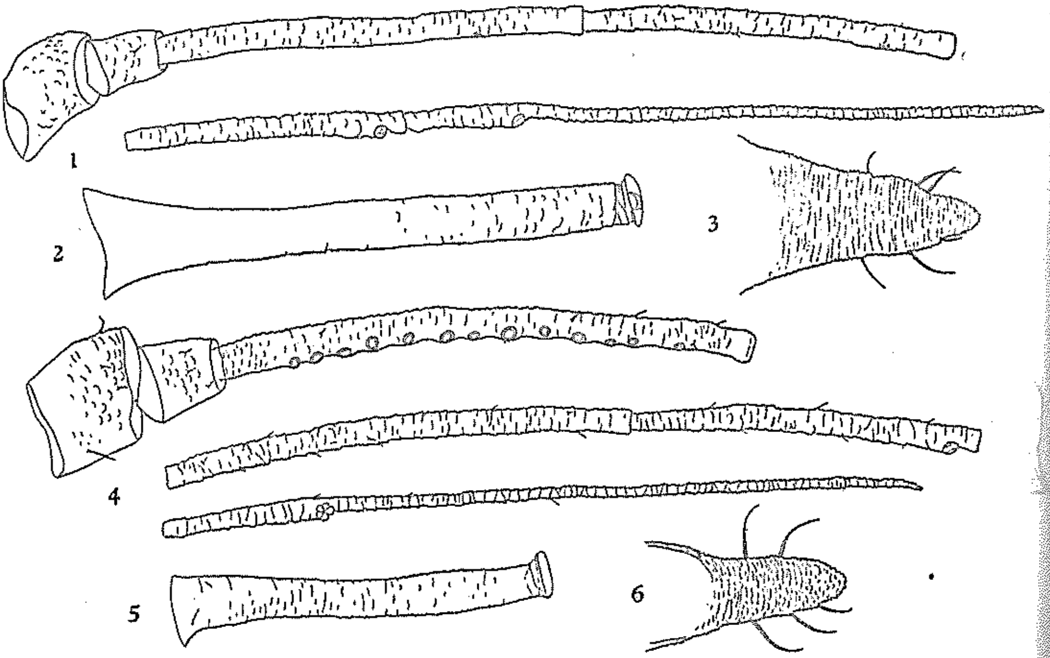

Fig. 3. *Myzus persicae* Sulzer

1. 2. 3. Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Myozoides persicae* van der Goot, 1913; *Rhopalosiphum persicae* Matsumura, 1917.

Hosts; Aceraceae: *Acer* sp.; Apocynaceae: *Nerium indicum;* Borraginaceae: *Bothriospermum chinense;* Caryophyllaceae: *Stellaria aquatica;* Chenopodiaceae: *Chenopodium album;* Compositae: *Chrysanthemum* sp., *Lactuca oldhami, L. sativa, Petasites tricholobus, Senecio cineravia;* Convolvulaceae: *Ipomoea batatas, I. cairica, Merremia gemella;* Cruciferae: *Brassica campestris, B. chinensis, B. napus, Capsella bursapastoris, Raphanus sativus, R.* sp.; Leguminose: *Pisum sativum;* Malvaceae: *Abelmoschus moschatus, Hibiscus albomoschus;* Myrtaceae: *Eucalyptus robusta, Psid-*

ium guajava; Papaveraceae: *Papaver somniferum;* Pedaliaceae: *Sesamum indicum;* Polygonaceae: *Polygonum multiflorum;* Rosaceae: *Prunus persica, P. mume;* Rutaceae: *Citrus spp.;* Scrophulariaceae: *Antirrhinum majus;* Solanaceae: *Lycium chinensis, Nicotiana tabacum, Solanum melongena, S. tuberosum;* Ulmaceae: *Zelkova formosana;* Verbenaceae: *Duranta plumieri.*

It rarely infests on *Citrus* spp. whether transmission tristeza or not is waiting for test but it is a major insect vector of other viruses of cultivated and wild plants and is a major tobacco, brassica pests on this island.

Distribution: China: Hainan, Taiwan, Kwangtung, Fuckien, Chekiang, Kiangsu, Shantung, Hopei, Liaoning, Szechuan and Sikong. This is a cosmopolitan species.

(3) *Aphis gossypii* Glover 1876 (Fig. 4)

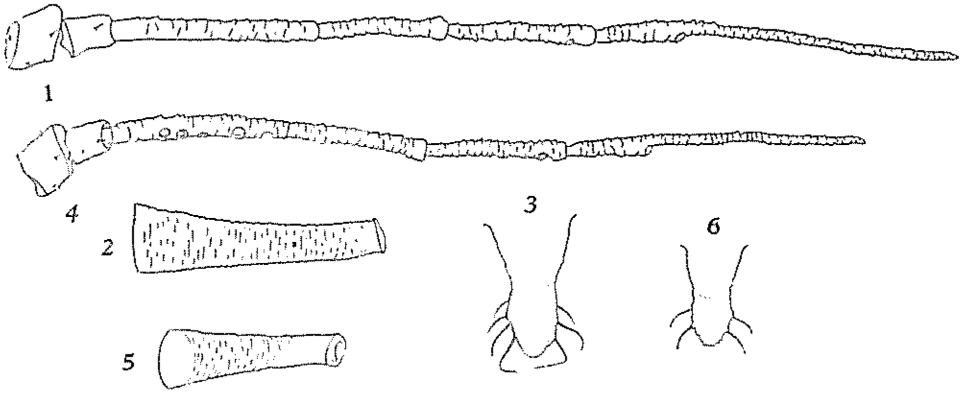

Fig. 4. *Aphis gossypii* Glover
1. 2. 3. Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Toxoptera odorikonis* Matsumura, 1917; *Aphis clerodendori* Matsumura 1917; *A. colocasiae* Matsumura, 1917; *A. malvae* Takahashi, 1921; *Toxoptera leonuri* Takahashi, 1921; *A. shirakii* Takahashi, 1921; *A. gossypii var. callicarpae* Takahashi, 1921; *A. vitifoliae* Shinji, 1922; *A. inugomae* Shinji, 1922; *A. bryoplyllae* Shinji, 1922; *A. hibiscifoliae* Shinji, 1922.

Hosts: Acanthaceae: *Justicia procumbens;* Araceae: *Caladium colocasia, Colocasia antiquorum, C. kotoensis;* Araliaceae: *Acanthopanax trifoliatum;* Bombaceae: *Bombax ceiba* Linn.; Casuarinaceae: *Casuarina equisetifolia;* Cammelinaceae: *Cammelina nudiflora;* Compositae: *Bidens pilosa, Blumea balsamifera. Chrysanthemum sinensis, C.* sp., *Cirsium segtum, Erigeron linifolius, Gnaphalium* sp., *Lactuca debilis;* Cruciferae: *Capsella bursapastoris;* Cucurbitaceae: *Citrullus vulgaris, Cucumis sativus, Cucurbita maxima, C. pepo;* Euphorbiaceae: *Breynia* sp., *Euphorbia hirta, E.* sp., *Phyllanthus reticulatus;* Hamamelidaceae: *Liquidambar formosana;* Libiatae: *Leonurus sibiricus, Perilla ocymoides, Salvia coccinea, Marubium supinum;* Leguminose: *Bauhinia blakeana, Glycine hispida, Medicago sativa;* Lythraceae: *Lawsonia*

inermis; Magnoliaceae: *Magnolia deundata;* Malvaceae: *Abelmoschus esculentus, A, moschatus, Gossypium* spp., *Hibiscus rosasinensis, H.* sp., *H. syriacus;* Melastomataceae: *Melastoma candidum;* Moraceae: *Broussonetia papyrifera, Ficus* sp.,; Myrtaceae: *Eucalyptus* sp., *Eugenia jambos, Psidium guajava;* Nyctaginaceae: *Bougainvillaea spectabilis;* Polygonaceae: *Antigonon leptopus, Fagopyrum esculentum;* Portulaceae: *Portulaca oleracea;* Punicaceae: *Punica grantum;* Rosaceae: *Chaenomeles lagenaria, Eriobotrya japonica, E.* sp., *Malus* sp., *Pirus serotina;* Rubiaceae: *Gardenia jasminoides, Ixora chinensis, Ourouparis formosana, Rubia cordifolia;* Rutaceae: *Citrus* spp., *Zanthoxylum bungei, Z. simulans;* Saliaceae: *Salix babylonia, S. warburgi;* Scrophulariaceae: *Paulownia tomentosa;* Solanaceae: *Lycoperscum esculentum melongena, S. torvum, S. tuberosum;* Urtiaceae: *Boehmeria nivea;* Valerianaceae *Valeriana valerianfolia;* Verbenaceae: *Callicarpa formosana, Clerodendron fortunnatum, C.* sp., *C. taichotomum, Tectona grandis. Vitex cannabiformis.*

It is occasionally found on *Citrus* spp. and the colour usually is gray but from other hosts, its colour is usually light yellow.

Distribution: China: Hainan, Taiwan, Kwangtung, Fuckien, Chekiang, Kiangsu, Shantung, Hopei, Liaoning, Szechuan, Sikong. This is a cosmopolitan species.

(4) *Aphis spiraecola* Patch 1914 (Fig. 5)

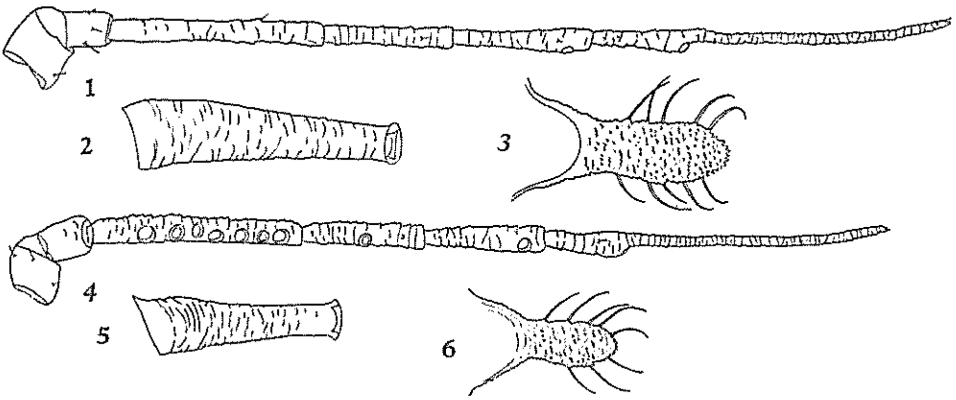

Fig. 5. *Aphis spiraeccola* Patch

1. 2. 3. Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Aphis pomi* Takahashi nec De Geer.

Hosts: *Spiraea cantonensis, S.* sp., *Dodonaea viscosa* Jacq. the last host was discovered by Dr. Evert I. Schlinger.

This species comes to near *Aphis pomi* De Geer, 1773, but *A. pomi* does not feed on *Citrus* spp.

Distribution: China: Taiwan, Kwangtung, Fuckien. Formerly known from United States of America.

(5) *Toxoptera odinae* (van der Goot, 1917) (Fig. 6)

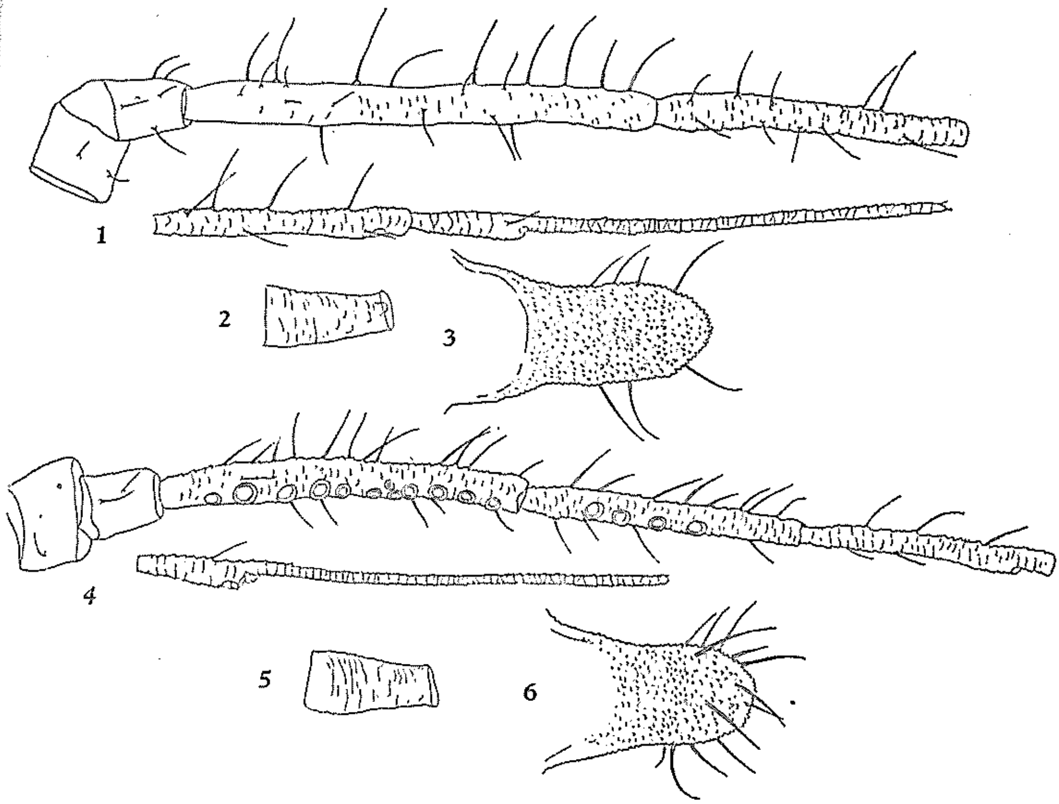

Fig. 6. *Toxoptera odinae* (van der Goot)
1. 2. 3. Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Longiungius odinae* van der Goot, 1917; *Arimakia araliae* Matsumura, 1917; *Arimakia taranbonis* Matsumura, 1917; *Aphis somei* Essig et Kuwana, 1918; *Aphis ficicola* Takahashi, 1921; *Aphis rutae* Shinji, 1922; *Aphis mokulen* Shinji. 1922; *Somaphis somei* Shinji, 1929; *Somaphis sansho* Shinji, 1932.

Hosts: Anacardiaceae: *Mangifera indica, Rhus chinensis, R. semialata;* Araliaceae: *Acanthopanax trifoliatum, Agalma lutchuense;* Burseraceae: *Canarium album;* Caprifoliaceae: *Viburnum formosanum, V. odoratissimum, V.* sp.; Euphorbiaceae: *Bischofia javanica, Fluggea virosa, Sapium sebiferum;* Moraceae: *Ficus wrightiana;* Guttiferae: *Garcinia multiflorae;* Myrtaceae: *Eucalyptus robusta;* Pittosporaceae: *Pittosporum tobira;* Polygonaceae: *Polygonum multiflorum;* Rubiaceae: *Wendlandia paniculata;* Rutaceae: *Citrus* spp., *Zanthoxylum nitidum.*

This species is rarely found on *Citrus* spp.

Distribution: Taiwan, Kwangtung, Fuckien, Chekiang, Kiangsu, Szechuan, Honan; Korea, Japan, India, Thailand, Malaya, Sumatra.

(6) *Toxoptera aurantii* (Boyer de Fonscolombe, 1841) (Fig. 7)

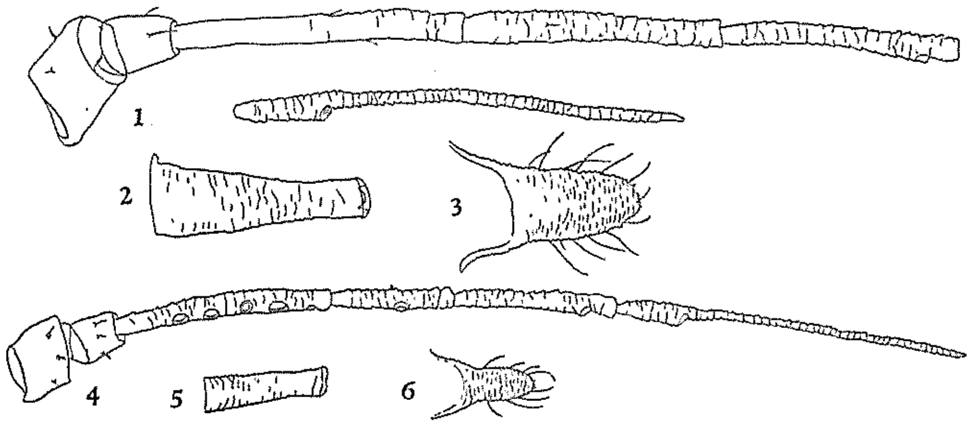

Fig. 7. *Toxoptera aurantii* (Boyer)

1. 2. 3 Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Aphis aurantii* B. d. F., 1841; *Aphis camelliae* Kaltenbach, 1843; *Toxoptera aurantiae* Koch, 1857; *Aphis coffeae* Nietner, 1861; *Myzus* (*Ceylona*) *theaecola* Buckton, 1891; *Toxoptera theobromae* Schouteden, 1906; *Aphis citrifoliae* Shiraki, 1913; *Toxoptera alaterni* De Geer, 1909; *Toxoptera variegata* Del Guercio, 1909; *Toxoptera aurantii limonii* Del Guercio, 1914; *Aphis coffeae thomensis* De Seabra, 1921.

Hosts: Anachardiaceae: *Mangifera indica;* Annonaceae: *Annona onuricata, A.* sp.; Apocynaceae: *Trachelospermum jasminoides;* Aquifoliaceae: *Ilex rotunda;* Araceae: *Caladium* sp.; Borraginaceae: *Ehretia buxifolia, E. microphylla;* Camelliaceae: *Thea chinensis, T. japonica, T.* sp., *T. caudata;* Caprifoliaceae: *Viburnum odoratissimum;* Euphorbiaceae: *Macaranga tanarius;* Fagaceae: *Quercus* sp.; Flacourtaceae: *Scolopia crenata, Xylosma racemosium var. kwangtungensis; F. fovolata,* Moraceae: *Artocarpus integra, Cassia glauca, Ficus akeotsang, F. pumila, F. retusa, Morus alba, M, australis, M. bombycis;* Myrtaceae: *Eucalytus rubusta, Maesa tenera;* Pittosporaceae: *Pittosporum tobira;* Rhamnaceae: *Sageretia theezans;* Rutaceae: *Acronychia pedunculata, Citrus* spp., *Murraya exotica, M. augusta, M. paniculata;* Rubiaceae: *Coffea arabica, Gardenia florida, G. jasminoides, Randia sinensis, R. spinosa;* Saliaceae: *Salix babylonica, S. warburgi;* Styracaceae: *Styrax suberifolium;* Sterculiaceae: *Theobroma cacao;* Ulmaceae: *Zelkova schneideriana;*

It is very common on *Citrus* spp. over the island.

Distribution: China: Taiwan, Kwangtung, Fuckien, Chekiang, Szechuan; Other tropical and subtropical countries.

(7) *Toxptera citricidus* (Kirkaldy, 1907) (Fig. 8)

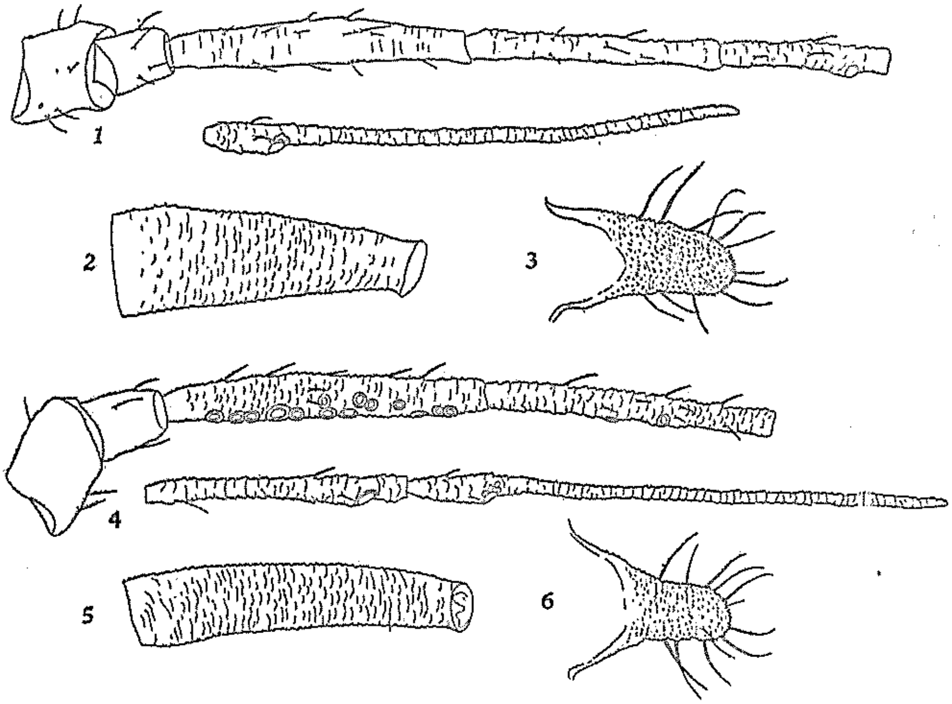

Fig. 8. *Toxoptera citricidus* (Kirkaldy)

1. 2. 3. Antenna, siphunculus and cauda of aptera; 4. 5. 6. Antenna, siphunculus and cauda of alate.

Synonyms: *Myzus citricidus* Kirkaldy, 1907; *Aphis tavaresi* del Guercio, 1908; *Aphis citricola* van der Goot, 1912; *Paratoxoptera argentinensis* Blanchard, 1944.

Hosts: Bombaceae: *Bombax ceiba* Linn.; Camelliaceae: *Camellia japonica;* Euphorbiaceae: *Bridelia monoica, Bridelia ovata;* Flacourtiaceae: *Xylosma congestum* Merr.; Lauraceae: *Cinnamomum camphora;* Moraceae: *Ficus retusa;* Rosaceae: *Eriobotrya* sp.; Rubiaceae: *Lasianthus chinensis;* Rutaceae: *Citrus* spp., *Murraya paniculata, Poncirus trifoliata, Zanthoxylum aviennae.*

It is very abundant on citrus during flush period over the island.

Distribution: China: Taiwan, Kwangtung, Yunan, Szechuan, Chekiang, Kiangsu; Corea, Japan, Lyuchu, India, Ceylon, Philippine, Hawaii, Malaya, Java, Sumatra, Fijii, New Guenia, South America, Africa. But it is still unknown from the citrus growing California, Florida of the United States and Mediterranean Area.

Among them, *Toxoptera citricidus* (Kirkaldy), *T. aurantii* (Boyer), *Aphis spiraecola* Patch and *A. gossypii* Glover have been proved as insect vectors of tristeza by both foreign and native virologists, the remaining three species, *Sinomegoura citricola* (van der Goot), *Myzus persicae* (Sulzer) and *Toxoptera odinae* (van der Goot) are not tested.

II. SEASONAL POPULATION SURVEY OF *TOXOPTERA CITRICIDUS* (KIRKALDY) AND *T. AURANTII* (BOYER)

Dr. Moericke discovered the yellow colour as the possitive tropism of aphids, using this method for surveying aphids instead of suction trap is much convenient. One Moericke yellow trap is set in Hsinpu, Hsinchu, It is carried out from February of 1959.

The structure of the yellow tray is shown as accompanying figure (Fig. 9). It is made of tin metal plate and painted with yellow colour. Two thirds fill with water, add a drop of detergent, change water, add detergent and clean bottom of tray daily or day intervals, keep and label the trapped aphids in a small glass containing with commercial alcohol, plug with absorbent cotton wool and put into alcohol bottle ready for identification.

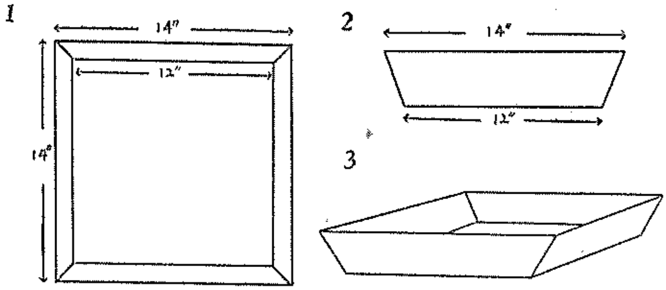

Fig. 9. Yellow tray diagram.
1. Above view, 2. Side view, 3. In use view.

Before identification, pin small holes on the abdomen of trapped specimens and soak in 10% caustic potash untill the internal contents softened and dissolved into the solution, about one day later, wash in distilled water and clear in clearing solution (saturated solution of chloral hydrate in Phenolum Liquefactum), mount in Berlese medium (gum arabic 12 g, glycerine 6.5 cc, chloralhydrate 20 g, distilled water 20 cc,. All the substance are dissolved in 40 cc cold water, filtered through glass wool and placed in incubator 30–40° C to evaporate the surplus water; the evaporation should be interrupted when the liquid has the desired visicosity) separately.

After mounting, examine under the miscroscope, if it is *Toxoptera citricicidus* (Kirkaldy) or *T. aurantii* (Boyer) put on one side and counted separately. Because of these two aphids are the major citrus pests and well known insect vectors of tristeza. The seasonal population curve is shown in Figure 10.

According to Figure 10, *Toxoptera citricidus* (Kirkaldy) is more than *T, aurantii* (Boyer) and the seasonal appearance is just the same. So far as we known, the trapped individuals come from citrus but very rarely from other hosts. There are two peak

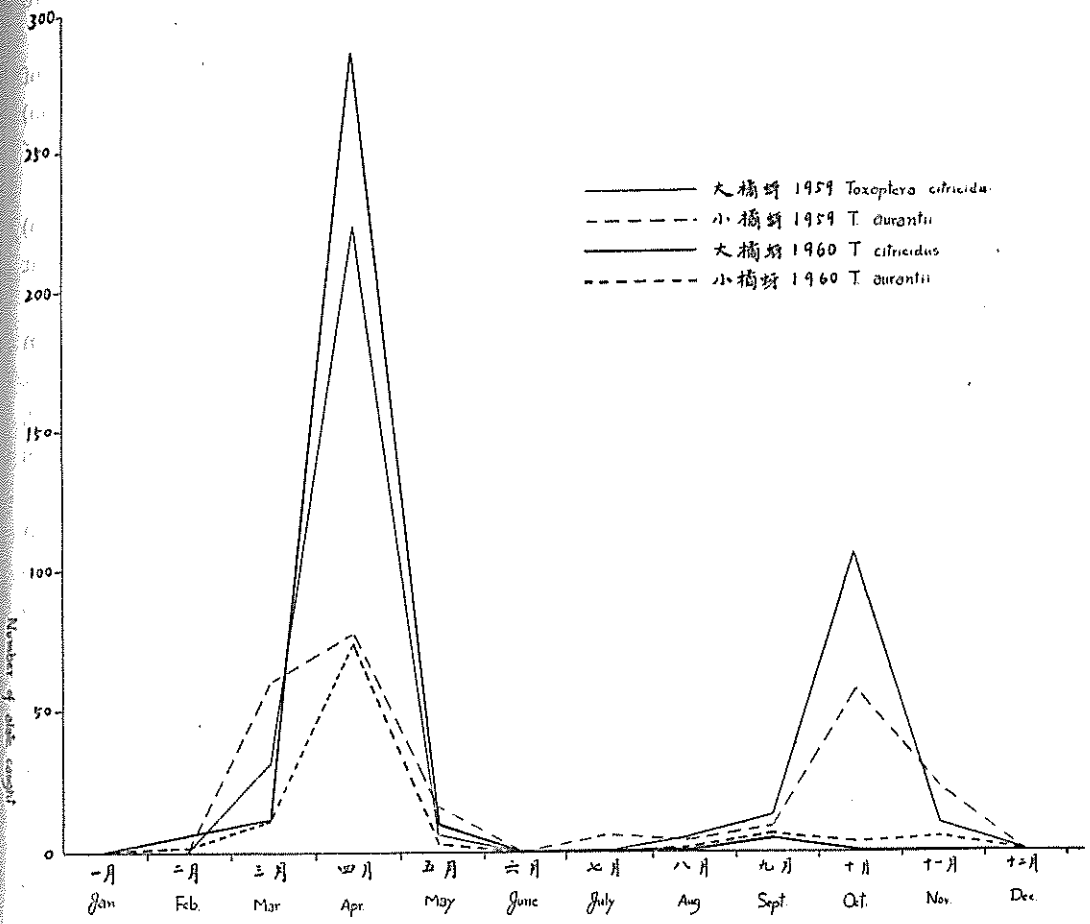

Fig. 10. Seasonal Population Survey of *Toxoptera citricidus* and *T. aurantii* at Hsinpu, Hsinchu during 1959–60.

periods, one is in April and the other in October. It cannot be used as the timing of aphicide application indicator. Proper time of aphicide application has to watch citrus flush period of different citrus species, varieties, growth and locations.

III. CHEMICAL CONTROL

Aphids are easy to be controlled with modern synthetic organic phosphorous compounds as malathion and botanical sources as rotenone, pyrethrin or nicotine sulphate and even scalicides as resin soda wash or oil is also effective. However, aphids are parthenogenetic, it completes on generation less than one week in favorite environment of temperature and nutrient, so that the reproduction is very high. If we neglect, it will cover all the tender foliage especially in spring flush period.

Moreover, Citrus standing in hillside where is hard to get sufficient water for spraying and *Aphis spiraecola* Patch lives within curl foliage thus to choice systemic

insecticides as metasystox and ekatin for more effective. The following results were obtained from the latest two years experiment.

Metasystox or methyl demeton, demeton-methyl, methylisosystox is a mixture of O, O-dimethyl O-2-(ethylthio) ethyl phosphorothioate and O, O-dimethyl S-2 (ethylthio) ethyl phosphorothioate. The ratio is 30:70. It is a Bayer product and contains 25% active ingredient in emulsive form.

Eaktin or thiometon is a trade name of O, O-dimethyl S-dimethyl S-2-(ethylthio) ethyl phosphorodithioate. It is a Sandoz product and contains 20% active ingredient in emulsive form.

Both having been tested as compared with malathion, they are much better than malathion and 0.1% metasystox or 0.05% ekatin concentration seems to be the most effective and economic. For getting better result it has to be applied in the fine day, when the plant is dried up completely and without any dew on the foliage thus making it quickly absorb and persist longer.

Bloom and flush of tristeza infested plants are irregularly but usually earlier than ordinary or healthy trees, therefore making first application on these infested plants to diminish migrants of citrus aphids fly to healthy late bloom and flush plants is the first key for reduction tristeza spreading.

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臺灣柑橘蚜蟲種類檢定和季節消長調查及藥劑防治試驗

陶 家 駒　　譚 梅 芬

本文敍述本省爲害柑橘之蚜蟲共七種，卽月橘蚜 *Sinomegoura citricola* (van der Goot) 桃蚜 *Myzus persicae* Sulzer，棉蚜 *Aphis gossypii* Glover，繡球蚜（捲葉蚜）*A. spiraecola* Patch，烏桕蚜 *Toxoptera odinae* (van der Goot)，小橘蚜 *T. aurantii* (Boyer de F.) 及大橘蚜 *T. citricidus* (Kirkaldy)，並有七種蚜蟲之檢別表。每種柑橘蚜蟲之同種異名、寄主（包括大陸）及分佈等，亦有扼要記述。

大橘蚜及小橘蚜爲本省最主要之柑橘蚜蟲，該二種在黃色誘蚜盆上之誘測記錄，亦有述及。一年中以四月及十月爲二個最盛期，但不能依此作爲藥劑撒佈最適時期。藥劑撒佈最適時期，須憑每次柑橘發芽期爲準。

治蚜藥劑經實地試驗結果以官能殺蟲劑中之 ekatin (thiometon) 20% ec×400 (0.05%) 或 methyl iso systox (metasystox) 25% ec×250 (0.1%) 爲最安全可靠。同時亦可防治柑橘紅蜘蛛及橘潛蛾等害蟲，因此可以提倡採用，並於晴天晨露乾後撒佈最宜，如能注意生育不正常之柑橘，先行澈底防治，收效更大。

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